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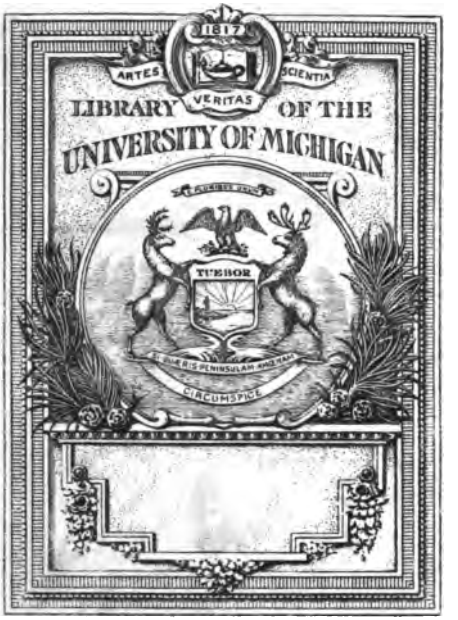
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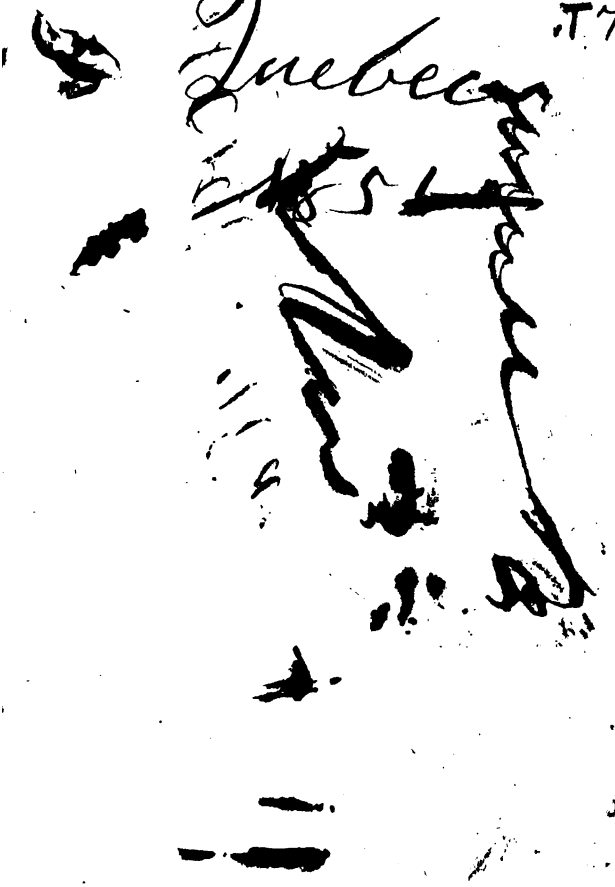

ON,

15

A

TREATISE

OF

ARITHMETIC,

DESIGNED FOR THE USE OF THE

ELEMENTARY SCHOOLS;

FOLLOWED BY THE

PRINCIPLES FOR MEASURING THE SURFACE,

AND THE

SOLIDITY OF THE BODIES.

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EXPLANATION OF ARITHMETICAL TERMS AND SIGNS.

NUMBER is either a *unit*, or consists of a *collection* of units; being the name given to our conception of things considered as *one* or *many*.

ABSTRACT NUMBERS. When we consider numbers in their general nature, without referring them to any particular subject, they are then called *abstract*; as 3, 7, 10, &c.

CONCRETE OR APPLICATE NUMBERS. When we consider number not in its general nature, but as applied to certain particular things, as, two pounds, three pence, &c., it is termed *concrete* or *applicate*.

A WHOLE NUMBER consists of one or more units.

A FRACTION consists of one or more parts of unity.

A MIXED NUMBER consists of a whole number and a fraction.

A COMPOUND NUMBER consists of several applicate numbers joined together in one expression; as £4 6s 8d.

AN EVEN NUMBER is that which can be divided into two equal whole numbers.

An ODD NUMBER is that which cannot be divided into two equal whole numbers.

A PRIME NUMBER is that which can only be divided by itself and unity, without a remainder; and numbers are said to be prime to each other when no number but unity will divide both without a remainder.

A SQUARE NUMBER is the product of any number by itself.

A CUBE NUMBER is the product of a number and its square.

A COMPOSITE NUMBER is that produced by multiply-

2-21-47 ADE

ing two or more numbers together; thus $28=4\times7$ is a composite number, and 4 and 7 are called its *component* parts.

An ALIQUOT PART is a number which is contained in a greater an exact number of times; thus 4 is an aliquot part of 16, but not of 17, as it is contained exactly 4 times in the former, and in the latter 4 times and 1 over.

An INTEGER is any whole number; as, a pound, a mile, &c., or, 1, 2, 4, 6, 9, &c.

MINUEND is the greater number in Subtraction.

SUBTRAHEND is the less number.

MULTIPLICAND in Multiplication is the number to be multiplied or repeated.

MULTIPLIER is the number by which we multiply, or which expresses how often the multiplicand is to be repeated.

PRODUCT is the sum or result of the operation in Multiplication.

FACTORS. The multiplicand and multiplier are called *factors* of the product.

DIVISOR in Division is the number by which we divide.

DIVIDEND ..... is the number to be divided.

QUOTIENT ..... is the number which shows how often the divisor is contained in the dividend, or the result of the operation.

DENOMINATION in applicate numbers is the name of the subject to which the number is applied; as, pounds, shillings, yards, miles, &c.

NUMERATOR is the upper number of a fraction, and shows how many parts of unity are expressed by the fraction.

DENOMINATOR is the under number of a fraction, and shows into how many parts the unit is divided.

A COMMON MEASURE is any number that will divide two or more numbers without a remainder, and their *greatest common measure* is the greatest number that will do so; thus 2 is a common measure of 12 and 18, and 6 is their greatest common measure.

MULTIPLE. One number is said to be a *multiple* of

another when the former contains the latter an exact number of times; thus 8 is a multiple of 4.

A COMMON MULTIPLE of two or more numbers is any number that contains each of them an exact number of times, and the least number that will do so is called their LEAST COMMON MULTIPLE; thus 48 is a common multiple of 12, 6, and 4, and 12 is their least common multiple.

=(*equal to*)	denotes *equality;*	thus 21s.=1 guinea.
+(*plus*)	. . . . *addition;*	thus 6+4=10.
—(*minus*)	. . . . *subtraction;*	thus 7—3= 4.
×(*multiplied by*)	. . *multiplication;*	thus 4×3=12.
÷(*divided by*)	. . . . *division;*	thus 18÷ 6= 3.

: (*is to*) : : (*as*) are signs used in *proportion* to denote an *equality* of *ratios;* thus 4 : 6 : : 8 : 12 denote that the *ratio* of 8 to 12 is the same as that of 4 to 6, and is read, 4 is to 6 as 8 is to 12.

¼ represents a *farthing*, or the *quarter* of any thing.
½ . . . . . a *halfpenny*, or the *half* of any thing.
¾ . . . . . *three farthings*, or *three quarters* of any thing.

ARITHMETICAL TABLES.

MONEY TABLE.

4 farthings *q.*	= 1 penny, marked *d.*	*dwt.*	*grs.*	
12 pence	= 1 shilling,* silver *s.*	3	$15\frac{3}{11}$	
5 shillings	= 1 crown, *cr.*	18	$4\frac{4}{11}$	
20 shillings	= 1 pound or sov. gold, £	5	3·2745	
21 shillings	= 1 guinea, *G.*			

The coins of foreign nations are reckoned bullion, and are bought and sold according to their weight and fineness. In the following work a dollar is rated at 4*s.* 6*d.*; a moidore at 27*s.*; a joannes at 36*s.*; a merk at 13*s.* 4*d.*; a pound Scotch is one-twelfth of a pound, or 20 pence; a pound Irish is twelve-thirteenths of a pound, or 13 pence Irish is equal to 1 shilling sterling.

TROY OR GOLDSMITHS' WEIGHT.

$\frac{1}{2}\frac{0}{5}\frac{0}{2}\frac{0}{4}\frac{0}{5}\frac{0}{8}$ of a cubic inch of water	= 1 grain, marked	*gr.*
24 grains	= 1 pennyweight,	*dwt.*
20 pennyweights	= 1 ounce,	*oz.*
12 ounces, or 5760 grains	= 1 pound,	*lb.*

This weight is used for comparing different weights

* A pound troy of sterling silver contains 11 ounces 2 dwts. of pure silver, and 18 dwts. of pure copper, and is coined into 66 shillings.

A pound troy of sterling gold contains 11 ounces of pure gold, and 1 ounce of alloy, which is composed of equal parts of pure silver and copper. It is coined into $46\frac{2}{4}\frac{9}{0}$ sovereigns. The coin called a guinea is not now in use.

with each other; and for weighing gold, silver, jewels, &c.

APOTHECARIES' WEIGHT.

20 grains	= 1 scruple, marked	℈
3 scruples	= 1 dram,	ʒ
8 drams	= 1 ounce,	℥
12 ounces	= 1 pound,	℔

This weight is used only for medical prescriptions.

AVOIRDUPOIS OR GROCERS' WEIGHT.

16 drams, *dr.*	= 1 ounce, marked *oz.*	= 437½ grs. troy.
16 ounces	= 1 pound,	*lb.* = 7000
14 pounds	= 1 stone,	*st.*
28 pounds	= 1 quarter,	*qr.*
4 qrs. or 112 lbs	= 1 hundredweight,	*cwt.*
20 hundredweight	= 1 ton,	*T.*

This weight is used for all articles sold by weight, except those mentioned under troy weight.

The avoirdupois pound is heavier than the troy pound by 1240 grains. 144 lbs. avoirdupois = 175 lbs. troy, and 192 oz. avoirdupois = 175 oz. troy.

LINEAL MEASURE.

12 lines	= 1 inch, marked	*in.*
12 inches	= 1 foot,	*ft.*
3 feet	= 1 yard,	*yd.*
5½ yards	= 1 pole,	*po.*
40 poles, or 220 yards	= 1 furlong,	*fur.*
8 furlongs, or 1760 yards	= 1 mile,	*ml.*

A pendulum vibrating seconds of mean time, in a

* Any quantity of gold, as a pennyweight, is supposed to be divided into 24 equal parts called *carats*. When the whole is pure, it is said to be 24 carats fine; when 23 grains are pure and one is alloy, it is said to be of 23 carats fine, and so on. Wrought gold is of two standards—the one 22 carats, and the other 18 carats fine.

For diamonds and pearls, a carat is a weight or 4 diamond grains, each of them four-fifths of a troy grain; 7½ carats of 30 diamond grains make a pennyweight troy, and 150 carats make a troy ounce.

vacuum at the level of the sea, in the latitude of London, is = 39·1393 inches.

An inch is sometimes divided into 8 and 16, and also into 10 parts; a fathom is 6 feet; a hand is 4 inches; the chain used for measuring land is 66 feet, and it is divided into 100 links, each of them 7·92 inches.

CLOTH MEASURE.

2¼ inches	= 1 nail, marked	*n.*
4 nails, or 9 inches	= 1 quarter of a yard,	*qr.*
4 quarters, or 36 inches	= 1 yard,	*yd.*

3 quarters = 1 Flemish ell; 5 quarters = 1 English ell;
6 quarters = 1 French ell; 37 inches = 1 Scotch ell.

GEOGRAPHICAL OR NAUTICAL MEASURE.

A nautical mile = 6075⅘ feet,
3 such miles = 1 league, marked *leag.*
20 leagues = 1 degree, *deg.* or °
360 degrees = the earth's circumference = 131237500 feet, or 24855½ miles nearly.

SQUARE OR SUPERFICIAL MEASURE.

144 square inches, *s. in.*	= 1 square foot, marked	*s. f.*
9 square feet	= 1 square yard,	*s. yd.*
30¼ square yards	= 1 square pole or perch,	*s. p.*
40 perches	= 1 rood,	*r.*
4 roods	= 1 acre,	*a.*
640 acres	= 1 square mile,	*s. m.*

36 square yards are a rood of building, and 100 square feet are a square of flooring.

10,000 square links make 1 square chain, and 10 square chains, or 100,000 square links, make 1 acre.

CUBIC OR SOLID MEASURE.

1728 cubic inches, *c. in.*	= 1 cubic foot, marked	*c. f.*
27 cubic feet	= 1 cubic yard,	*c. y.*
40 cubic ft. of rough, or 50 cubic feet of hewn timber	= 1 load,	*lo.*
42 cubic feet	= 1 ton of shipping,	*T. sh.*
5 cubic feet	= 1 barrel bulk,	*B. B.*

MEASURE OF CAPACITY.

			Cubic inches.
5 oz. of avoir. of water	= 1 gill, marked	*gi.* =	8·3324
4 gills	= 1 pint,	*pt.* =	34·6592
2 pints	= 1 quart,	*qt.* =	69·3185
4 quarts	= 1 gallon,	*ga.* =	277·2738
2 gallons	= 1 peck,	*pk.* =	554·5477
4 pecks	= 1 bushel,	*bu.* =	2218·1907
8 bushels	= 1 quarter,	*qr.* =	17745·5260

This measure is used both for liquids and dry goods. 100 gallons of this measure are equal to 120 old wine gallons, or to 98·3 ale gallons, or to 103·15 gallons dry measure; and the Winchester bushel is equal to 7·7556 standard gallons, or to ·9694 standard bushels. 5 quarters make a load.

TIME.

60 seconds, *sec.*	= 1 minute, marked	*min.*
60 minutes	= 1 hour,	*ho.*
24 hours	= 1 day,	*da.*
7 days	= 1 week,	*we.*
4 weeks	= 1 common month,	*mo.*
13 common months and 1 day, or 52 weeks & 1 day, or 365 days	= 1 common year,	*co. ye.*
365¼ days	= 1 Julian year,*	*Ju. ye.*
366 days	= 1 bissextile or leap year.	

The year is also divided into 12 calendar months, viz:

January 31 days	May 31 days	September 30 days
February 28 —	June 30 —	October 31 —
March 31 —	July 31 —	November 30 —
April 30 —	August 31 —	December 31 —

* The true solar or tropical year is 365 days 5 hours 48 minutes 48 seconds, which is 11 minutes 12 seconds less than the Julian year, and this difference makes 3 days 2 hours and 40 minutes in 400 years. To regulate this it has been fixed, that when a number denoting a complete century is not divisible by 4, as the 18th, 19th, 21st, and so on, such years should not be reckoned leap years, but common years.

The number of days in each month may be easily remembered from the following rhymes:

Thirty days hath September,
April, June, and November;
All the rest have thirty-one,
Excepting February alone,
Which hath but twenty-eight days clear,
And twenty-nine in each leap year.

ANGULAR MEASURE OR DIVISIONS OF THE CIRCLE.

	seconds, marked	″
60 seconds	= 1 minute,	′
60 minutes	= 1 degree,	°
30 degrees	= 1 sign,	*s.*
12 signs	= 1 circle,	*circ.*

YARN MEASURE.

COTTON YARN.	LINT YARN.
54 inches = 1 thread,	90 inches = 1 thread, *thr.*
80 threads = 1 skein or rap,	120 threads = 1 cut, *cu.*
7 skeins = 1 hank,	2 cuts = 1 heer, *he.*
18 hanks = 1 spindle.	6 heers = 1 hasp, *ha.*
	4 hasps = 1 spindle, *sp.*

The ounce thread reel is only 36 inches, and 30 such threads make one hank.

APOTHECARIES' FLUID MEASURE.

			Cubic inches.
	1 fluid minim, marked	♏ =	0·0045
60 fluid minims	= 1 dram,	ʒ =	0·2708
8 drams	= 1 ounce,	℥ =	2·1662
16 ounces	= 1 pint,	○ =	34·6592
8 pints	= 1 gallon,	*gall.* =	277·2738

FLOUR AND BREAD WEIGHT.

A peck-loaf weighs	17 lbs.	6 oz. avoirdupois
A half-peck do	8	11
A quarter-loaf	4	5½

A peck of flour ought to weigh 14·44 lbs., or 14½ lbs. very nearly; and the standard bushel 57·76 lbs., or 57¾ lbs. Five bushels make a sack, which ought to weigh 288·8 lbs.

HAY AND STRAW WEIGHT.

36 lbs. avoirdupois	of straw	= 1 truss,	marked *tr.*
56 lbs. ditto	of old hay	= 1 truss,	
60 lbs. ditto	of new hay	= 1 truss,	
36 trusses		= 1 load,	*lo.*

The hay of any year is reckoned old after the end of August.

A load of straw is 11 cwt. and 64 lbs.; a load of old hay is 18 cwt., and a load of new hay 19 cwt. 32 lbs.

THE QUARTERLY TERMS.

IN ENGLAND.

Lady-day, 25th March,	Michaelmas, 29th September
Midsummer, 24th June,	Christmas, 25th December.

THE

PRINCIPLES OF ARITHMETIC.

ARITHMETIC is the science of numbers; it explains their properties, and the art of computing by them.

All numbers are expressed by the ten following marks:

One,	unit,	two,	three,	four,	five,	six,	seven,	eight,	nine,	cipher.
1		2	3	4	5	6	7	8	9	0

The first nine of these marks are called *digits*, or significant figures, but the last has no value.

NUMERATION.

Numeration is the art of reading a number expressed in figures.

A figure placed singly, or on the right hand of other figures, represents so many ones, or it retains the name and value given to it above.

A figure in the second place, or having a significant figure on the right hand of it, represents so many tens, and is read with the termination *ty* after its name. Thus, 10 ten, 20 twenty, 30 thirty, 40 forty, &c.

The cipher serves to bring figures to their proper places, by supplying vacant places. Thus, 7 is seven, 70 is seventy.

When a unit is on the left hand of a significant figure, it is commonly read after it, and called *teen*, except 11 eleven and 12 twelve; thus, 13 thirteen, 14 fourteen, &c.

A digit in the third place denotes so many hundreds, as 200 two hundreds. Thus, 8 eight, 80 eighty, 800 eight hundred, 808 eight hundred and eight, 880 eight hundred and eighty.

Hence, all numbers between 10 and 100 require two figures to express them; and all numbers between 100 and 1000 require three figures. A cipher on the left hand of a number does not affect its value.

Read, and write in words the following:

21—12—31—13—70—71—17—28—82—60—37—73—46—64—19—91—48—84—61—16—58—130—103—301—310—111—101—391—319—913—931—584—607—790—810—987—444—116—281—706—909—990—315—575.

When the number consists of more than three places.

RULE. Divide it from the right hand into parce'ls of three figures, by placing a comma at the left hand of the first three, a period after the next three, and so on, a comma and a period alternately. Then, beginning at the left hand, read each parcel by itself, and call the periods millions, and the commas thousands.

For example, the number 123456789 is pointed thus, 123.456,789, and it is read one hundred and twenty-three millions, four hundred and fifty-six thousand, seven hundred and eighty-nine.

A number consisting of more than nine places is seldom read; but the student, in order to acquire facility of expression, may read any number in the same way, calling every period *millions*, and every comma *thousands*. When he is farther advanced in arithmetic, he will easily learn to call the second period from the right hand bi-millions or billions, the third period tri-millions or trillions; after which he will denominate the following periods, quadrillions, quintillions, sextillions, septillions, octillions, nonillions, &c. in their order, as in the following table:—

NUMERATION TABLE.

65.	070,	826,	005,	800,	705,	089,	103,	060,	574,	684
nonillions	tens of octillions	hundreds of octillions	septillions	tens of septillions	hundreds of septillions	sextillions	tens of sextillions	hundreds of sextillions	quintillions	tens of quintillions	hundreds of quintillions	quadrillions	tens of quadrillions	hundreds of quadrillions	trillions	tens of trillions	hundreds of trillions	billions	tens of billions	hundreds of billions	millions	tens of millions	hundreds of millions	thousands	tens of thousands	hundreds of thousands	units	tens of units	hundreds of units

Write in words, or read, the following:

9547,—8264,—5809,—46837,—87654,—14036,—60403,—21008,—30061,—80004,—67420,—10101,—10000,—150700,—705420,—8427153,—611211,—680000510,—204060805,—500700800,—21003100.

NOTATION.

Notation is the method of expressing in figures any number given in words.

RULE. Write a sufficient number of ciphers or dots, and point them, to determine their places; then observe what place each figure of the given number should occupy, and, erasing the cipher or dot there, write the figure in its room.

Ten thousand, six hundred and four,	00,000 10,604

Express in figures the following:

Two hundred and thirty-four;—thirty-eight;—seven hundred and fifty;—one thousand and four;—twenty thousand, eight hundred and three;—seventy-six thousand and fourteen; three hundred and thirteen; two hundred thousand and eleven; four hundred and eighty thousand and sixty;—six hundred and fifty thousand and ninety;—nine billions;—twenty-four trillions;—three hundred millions, twelve thousand and four.

Express in figures the following distances of the planets from the sun in miles:

Mercury, thirty-seven millions;—Venus, sixty-nine millions;—the Earth, ninety-five millions;—Mars, one hundred and forty-five millions;—Jupiter, four hundred and ninety-four millions;—Saturn, nine hundred and seven millions; and Herschel, one thousand eight hundred and ten millions.

ROMAN NOTATION.

The Romans used the following letters for numbers: I one, V five, X ten, L fifty, C a hundred, D or Iↀ five hundred, and M or CIↀ a thousand.

When any letter was followed by another of equal or less value, the expression denoted the sum of their simple values, as II two, III three, CCC three hundred, VI six, XII twelve, LXX seventy, CCXX two hundred and twenty.

When a character preceded one of greater value, the expression denoted the difference of their simple values, as IV four, XL forty, XC ninety.

Every ↀ annexed to I ↀ, and every C and ↀ joined to CIↀ, increased the value ten times, as Iↀↀ five thousand, CCIↀↀ ten thousand.

A line drawn over a letter increased its value a thousand times, as $\overline{V}$ five thousand, $\overline{C}$ a hundred thousand.

Read VIII, XIII, XVII, XIX, XL, LX, LXX, CCVII, DCC, MDCCCXXVI, MDCCCXXX, MDCCCCX.

ADDITION.

Addition is the method of finding a number equivalent to two or more numbers taken together.

The number found is called the *sum*, or *amount*.

If the numbers 8 and 7 are to be added, we begin at 8, and reckon 7 more, or we begin at 7 and reckon 8 more; the result in either case is 15.

8
7
15

In performing the work, we place the one number under the other as in the margin, and we write the sum, so that the 5 may be under the figures, and the 1 in the second place, or that of tens.

If the 8 and 7 are in the second place, as 80 and 70, it is plain that the sum 15 ought to be in the second place, or have a cipher on the right of it, as 150

70
80
150

If the numbers consist each of two figures, as 87 and 79, having written one under the other, we may add 8 and 7, which are in the second place, and write the sum 15 in the second place, or write a cipher on the right of it; then, adding 9 and 7, their sum 16 must have the 6 in the first place, and the 1 in the second. And because 5 and 1 are both in the second place, we add them, and write the whole sum 166 below.

	87
	79
	15
	16
	166

This sum may be obtained at once, by first finding the sum 16 of the right-hand figures; then we write the 6 under the right-hand column, and carry the 1 to the next, saying 1 and 7 are 8 and 8 are 16, which we write in the second and third columns. And in the same way we may add any numbers together.

	87
	79
	166

ADDITION TABLE.

1	2	3	4	5	6	7	8	9
2	4	5	6	7	8	9	10	11
3	5	6	7	8	9	10	11	12
4	6	7	8	9	10	11	12	13
5	7	8	9	10	11	12	13	14
6	8	9	10	11	12	13	14	15
7	9	10	11	12	13	14	15	16
8	10	11	12	13	14	15	16	17
9	11	12	13	14	15	16	17	18

To read this table. Find one of the figures in the left-hand column, and go along that line to the column which has the other figure at the top, and there you will find the sum.

After the pupil has committed this table to memory, he should be exercised in inferring from it the sum arising from the addition of a figure to a number of two places; thus, 8 and 7 are 15, therefore 18 and 7 are 25, 28 and 7 are 35, &c., where all the right hand figures are the same, and the second figures are increased by 1.

RULE. Place the numbers under one another, so that their right hand figures shall make one column, their second figures another, and so on.

Add the figures of the right-hand column, and if the sum is one figure, write it under that column; but if it consists of more, write only the right-hand figure of it under that column, and carry the rest to the second column.

Add all the other columns, with the carriages to them, in the same manner, and under the left-hand column write the entire sum of it.

PROOF. Repeat the operation, beginning at the top; or add so many of the given numbers, and to the sum add the rest.

1st,	2d,	3d,	4th,	5th,	6th,
3214	2413	3264	3251	4250	6758
1230	1342	2415	4235	3521	9364
2401	4231	4352	2354	5434	8975
2312	3124	5123	5413	3245	7468

7th, 23458+58317+47645+83907.
8th, 45825+31703+64561+72986.
9th, 54473+32894+10658+46801.
10th, 47372+89495+65844+72987.
11th, 99647+63852+87483+58274.
12th, 3460+2435+6253+4635+3456.
13th, 3521+4235+5364+7182+2467.
14th, 6243+4632+3426+2574+5736.
15th, 2437+5623+4572+7356+4265.
16th, 6428+7365+5274+3456+2864.
17th, 8249+6875+4867+9278+3706.
18th, 2463+5174+6347+3526+4735.
19th, 4638+5273+1648+4678+8754.
20th, 3692+857+9476+4758+56.
21st, 7531+46+6372+985+5689.
22d, 4685+6874+840+9+7967.
23d, 6940+8567+9154+6035+4689.
24th, 57481+76543+92867+89670+68795+47806.

25th, 82714+90867+45179+28798+76486+75906.

26th, 75243+53987+27850+84675+58041+98736.

27th, 67589+17428+79075+28842+47969+79528.

28th, 49+57+384+5768+97352+4086.

29th, 87054+91385+64582+31579+74923+82794+64785.

30th, 30845+87209+48163+46567+86954+28483+95867.

31st, 82793+65847+29372+96475+47198+86759+64658.

32d, 64075+3192+79608+25384+91670+4709+826.

33d, 79356+24862+5893+91756+648+28753+6479.

34th, 928642+643789+879784+724423+647590+874828+506407+289369.

35th, 862759+178596+371982+270937+796801+384947+169075+849678.

36th, 258118+74456+688+909475+32847+991116+93688+785495.

37th, 828093+9386+89364+258+687510+34567+123897+7676.

38th, 893645+275224+571448+765030+949861+426827+574926+492868.

39th, 8628409+4683754+7254936+8657849+3842369+7854900+6839456+4795021+8991824.

40th, 34763450+56871936+12345678+93648752+7494675+985421+67891+72936428+29368.

41st, 526794256+679362080+17736+368428+9570572+72575158+973826475+956284083+987654321.

42d, 69147873734+23781094851+75849956926+2577805734+8784158854+73174498937+22534567890+628475987+62846372498.

43d, 79368+94753+3968+4536+93688+3456.

44th, 82893+45+815526+456+42682+7676+96734+124735869+3749286.

45th, 9482+39867+29479+48927+9276+850+5273+98+7000+80072+19+8467.

46th, 978+749+4764+8967+94623+45237+77592+59286+89294+3789+2936+5700.

47th, 1926+39257+3834+92751+92503+6846+649+867+34935+2679+7934+286+674+39487.

48th, Add together six thousand two hundred and eighty-five; three thousand seven hundred and twelve; eight thousand four hundred and sixty; eleven thousand and eleven; eight thousand and sixty-three; three hundred and sixty-five; eight thousand and thirty-three; fifty thousand and forty-six; seven hundred and ten thousand one hundred and one; ninety-eight thousand seven hundred; and seven hundred and six thousand and eighty-six.

49th, Find the sum of seven hundred and sixty-four; three hundred and eighteen; eight millions six hundred and three thousand and twenty-two; seven thousand and four hundred; thirty million fifty thousand and five hundred; eight hundred thousand; seventy thousand and sixty; four hundred and twenty-seven.

SUBTRACTION.

Subtraction is the method of taking a less number from a greater.

The greater number is called the *minuend*, the less the *subtrahend*, and the number found is called the *remainder* or *difference*.

If 5 is to be taken from 9, we place them as in the margin; and beginning at 5, we reckon upwards to 9; and the number reckoned 4 is the difference required.

9
5
—
4

If 7 is to be taken from 43, we place the right-hand figures below one another; then we attempt

to take 7 from 3, and as this cannot be done, we may take 1 from the 4 in the second place, and prefix it to the 3, which makes 13; we take 7 from this, and place the remainder 6 under the right-hand figure; and having taken 1 from 4, the remainder 3 is put in the second place.

43	
7	
—	
36	

Instead of diminishing the second figure by 1, which is sometimes inconvenient, we add 1 to the under figure in the second place, and take the sum from the upper figure; the result is evidently the same.

Here the learner should be again referred to his addition table, and should be exercised upon it till he can tell, without hesitation, what two numbers added make 9, make 13, &c.; and also what number added to 6 makes 11, to 9 makes 14, &c.

RULE. Place the less number under the greater, so that their right-hand figures shall stand in the same column.

Take the right-hand figure of the lower from that of the upper, and write the remainder under it, and so of the other columns. When the under figure is greater than the upper, take it from 10, and add the upper figure to the remainder; but in this case I must be carried to the under figure of the next column before subtracting it.

PROOF. Add the remainder to the less number, the sum should be greater, or subtract the remainder from the greater, and it will leave the less.

1st,	2d,	3d,	4th,
From 81754	84207	67193	57132
Take 36123	36485	58246	42824

5th, From 103642 take 73825.
6th, " 114721 " 93478.
7th, " 246003 " 24670.
8th, " 90001 " 84003.
9th, " 67426 " 2987.
10th, " 24738 " 21896.
11th, " 100308 " 7204.
12th, " 168476 " 78903.

13th, From 40103 take 29018.
14th, " 37542 " 16789.
15th, " 601080 " 380994.
16th, " 810036 " 427942.
17th, " 572015 " 408427.
18th, " 901074 " 567890.
19th, " 730428 " 573806.
20th, " 362085 " 246809.
21st, " 430006 " 329998.
22d, " 571114 " 200070.
23d, " 610103 " 587094.
24th, " 721093 " 466805.
25th, " 5782438 " 1543627.
26th, " 6043862 " 57008.
27th, " 7003842 " 8749.
28th, " 10001037 " 64228.
29th, " 60425073 " 6281947.

(30) What is the difference between 597384 and 286375, (31) between 628475938 and 42863748, (32) between 6749 and 999, (33) between 810004007 and 754362, (34) between 101010101 and 2102102, (35) between five millions and one hundred and seven thousand eight hundred an forty-six.

MULTIPLICATION.

Multiplication is the method of finding what a number will amount to when it is repeated a certain number of times.

The two numbers are called *factors;* that to be repeated is the *multiplicand*, the number of times it is to be repeated is the *multiplier*, and the amount to be found is the *product*.

Before proceeding farther, the pupil must commit the Multiplication Table carefully to memory.

MULTIPLICATION TABLE.

2 times 2 are 4 2 — 3 — 6 2 — 4 — 8 2 — 5 — 10 2 — 6 — 12 2 — 7 — 14 2 — 8 — 16 2 — 9 — 18 2 — 10 — 20	5 times 5 are 25 5 — 6 — 30 5 — 7 — 35 5 — 8 — 40 5 — 9 — 45 5 — 10 — 50
3 times 3 are 9 3 — 4 — 12 3 — 5 — 15 3 — 6 — 18 3 — 7 — 21 3 — 8 — 24 3 — 9 — 27 3 — 10 — 30	6 times 6 are 36 6 — 7 — 42 6 — 8 — 48 6 — 9 — 54 6 — 10 — 60
4 times 4 are 16 4 — 5 — 20 4 — 6 — 24 4 — 7 — 28 4 — 8 — 32 4 — 9 — 36 4 — 10 — 40	7 times 7 are 49 7 — 8 — 56 7 — 9 — 63 7 — 10 — 70
	8 times 8 are 64 8 — 9 — 72 8 — 10 — 80
	9 times 9 are 81 9 — 10 — 90
	10 times 10 are 100

Suppose we were to inquire how many ways we could proceed to find the product of 6 and 9. If we write the 6 below the 9, we say 6 times 9 are 54, and we write the 4 under the 6, and the 5 in the second place. If we write the 9 under the 6, we say 9 times 6 are 54, which we write the same way, so that either number may be the multiplier.

9	6
6	9
—	—
54	54

Again, because 6 is the product of 3 and 2, we may multiply the 9 by 3, and the product by 2; or we may multiply the 6 by 3, and the product by 3, because 3 times 3 make 9.

9	6
3	3
—	—
27	18
2	3
—	—
54	54

Thirdly, We may multiply the 9 by any two numbers of which the sum is 6, as by 4 and 2, and then add the products, the sum will still be 54.

9	9
4	2
—	—
36	18
	36
	—
	54

These remarks explain the method of operation in every case.

To multiply 6 by 10 is only to put 6 in the second place, or to annex the cipher. To multiply 6 by 40 is to multiply 6 by 4, and to put the product 24 in the second place, and it becomes 240. The same would be the result of multiplying 40 by 6.

If we are to multiply 68 by 4, we multiply 8 by 4, and then 60 by 4, or 6 by 4, and put the product in the second place, and then add them, the product is 272. But the product may be found in one line by saying 4 times 8 are 32; we write the 2, and carrying the 3, we say 4 times 6 are 24, and 3 are 27, and we write the 7 in the second place, and the 2 in the third. To

68
4
—
32
24
—
272

multiply 79 by 35, having multiplied by 5, we next multiply by 30, or by 3, and write the product in the second place, and add them.

```
 79
 35
---
395
237
---
2765
```

RULE I. If the multiplier does not exceed 12, write it under the multiplicand, and draw a line under it. Multiply the right-hand figure of the multiplicand by it, and if the product is one figure, write it under the multiplier; if it is more than one figure, write its right-hand figure only, and carry the rest to the next product. Multiply in the same way the other figures of the multiplicand, adding the carriages to the products, and under the left-hand figure write the complete product.

If the multiplier exceeds 12, multiply in the same way as before, first by the right-hand figure of the multiplier, then by the next, and so on, taking care to place the products in distinct lines, and the right-hand figure of each under that figure of the multiplier from which it arises. After having multiplied by all the figures, add the products as they stand, and the sum is the product arising from the whole multiplier.

Ciphers on the right of either factor may be omitted in the work, but they must all be written on the right-hand of the product.

Hence to multiply by 10, 100, 1000, &c., is only to annex the ciphers to the multiplicand.

PROOF. Use the multiplicand for the multiplier, and the multiplier for the multiplicand. Or if the nines be thrown out of the two factors, and the remainders multiplied, it will be the same with the remainder when the nines are thrown out of the product.

1. Multiplicand 35798
   Multiplier 7

   Product 250586

2. 836547290
   40800

   669237832
   334618916

   34131129432000

3. Multiply 47963852 by 23
4. Multiply 25836974 by 45
5. Multiply 59826473 by 67
6. Multiply 64735982 by 89
7. Multiply 468209573 by 68
8. Multiply 759138248 by 97
9. Multiply 52007498 by 405
10. Multiply 91468379 by 809
11. Multiply 7964280 by 387
12. Multiply 496857 by 496
13. Multiply 683792 by 568
14. Multiply 719480 by 679
15. Multiply 876543 by 268
16. Multiply 920786 by 794
17. Multiply 862479 by 5370
18. Multiply 737870 by 9076
19. Multiply 846897 by 6807
20. Multiply 390867 by 5098
21. Multiply 934685 by 38709
22. Multiply 946587 by 608090
23. Multiply 896385 by 69874
24. Multiply 378600 by 750000
25. Multiply 6879000 by 87400
26. Multiply 8695720 by 975864

RULE II. When the multiplier is the product of two factors, neither of which exceeds 12, multiply successively by these factors.

27. Multiply 785964 by 15
28. Multiply 842976 by 21
29. Multiply 907584 by 22

30. Multiply 378549 by 27
31. Multiply 649857 by 28
32. Multiply 357928 by 35
33. Multiply 580726 by 44
34. Multiply 428571 by 54
35. Multiply 405719 by 96
36. Multiply 648391 by 121
37. Multiply 586974 by 144
38. Multiply 234567 by 132

DIVISION.

Division is the method of finding how often a less number is contained in a greater.

The less number is called the *divisor*, the greater the *dividend*, and the result is called the *quotient*.

When the dividend is not large, we can easily find from the multiplication table how many times it contains the divisor; but when it is large, we find, first, how many hundred or thousand times it contains the divisor; then how many ten times the remainder contains it; and, lastly, how many single times the next remainder contains it.

RULE I. Draw a curve-line on each side of the dividend, and write the divisor on the left hand of it.

If the first-figure of the divisor is not greater than the first of the dividend, point off as many towards the left of the dividend as are in the divisor; but if it is greater, point one figure more. Find how often the divisor is contained in these figures, and place the number of times in the quotient, on the right of the dividend. Multiply the divisor by this figure, and subtract the product from the figures pointed off, and to the remainder annex the next figure of the dividend. Divide the number thus obtained in the same manner, and so on till all the figures of the dividend have been used.

If, after bringing down a figure of the dividend to the remainder, it is still less than the divisor, write a cipher in the quotient, and bring down the next figure of the dividend.

If any product is greater than the number from which it is to be taken, the last figure in the quotient must be diminished; but if any remainder is not less than the divisor, the last figure in the quotient must be increased, and that part of the work repeated.

NOTE 1. When the divisor is large, beginners often find it difficult to determine the figure that should be put in the quotient. Take the first figure of the divisor out of the first or two first figures of the dividend, and to the remainder annex the next figure of the dividend; if this number does not contain the second figure of the divisor as often as the first was contained, the quotient figure must be lessened, and the work repeated till this takes place.

NOTE 2. To divide by 10, 100, 1000, &c. Cut off as many figures from the right of the dividend as there are ciphers, the rest give the quotient, and the figures cut off, the remainder.

NOTE 3. When there are ciphers on the right hand of the divisor, cut them off, and cut off as many figures from the right of the dividend, then divide by the other figures; and to the last remainder annex the figures cut off from the dividend.

PROOF. Multiply the quotient by the divisor, and to the product add the remainder, if any; the sum should be the dividend. Or cast the nines out of the divisor, dividend, quotient, and remainder. To the product of the excesses of the divisor and quotient, add that of the remainder; the excess of the sum above nine is equal to that of the dividend.

Divisor.	Dividend.	Quotient.
1. 73)	35478	(486
	292	73
	627	1458
	584	3402
	438	35478 Proof.
	438	

2. 386)1836588)4758

	1544
	2925
	2702
	2238
	1930
	3088
	3088

3.	Divide	10761513 by	21
4.	Divide	858786180 by	42
5.	Divide	360919856 by	83
6.	Divide	752836506 by	94
7.	Divide	473924676 by	76
8.	Divide	528637504 by	67
9.	Divide	579268053 by	39
10.	Divide	2753846316 by	309
11.	Divide	117594325 by	475
12.	Divide	218860161 by	689
13.	Divide	368429803 by	257
14.	Divide	637294835 by	598.
15.	Divide	364825703 by	789
16.	Divide	257438263 by	189
17.	Divide	178427538 by	4321
18.	Divide	369800425 by	6598
19.	Divide	264070308 by	6704
20.	Divide	246782946 by	3689
21.	Divide	471283640 by	1658
22.	Divide	369827583 by	46234
23.	Divide	297608350 by	36500
24.	Divide	257428600 by	78000

* When there is a remainder, place the divisor under it, with a line between them, and write the fraction thus formed at the end of the quotient.

25. Divide 3264752807 by 17009
26. Divide 205710680656992 0 by 28640
27. Divide 420126834752 by 157300
28. Divide 253791846253 by 345068
29. Divide 318998375040 by 497316
30. Divide 15359274703104 by 2719064

RULE II. If the divisor does not exceed 12, the operation may be performed by multiplying and subtracting mentally, and writing only the quotient under the dividend.

And if the divisor is the product of two numbers neither of which exceeds 12, the operation may still be performed mentally, by dividing first by one of these numbers, and the quotient by the other.

NOTE. To find the true remainder when there are two divisors, add the remainder of the first division to the product of the second remainder by the first divisor.

In the first example, we say the fives in 7 are 1, and 2 over. We write the 1 under the 7, and annex the next figure 4 to the remainder 2, and it makes 24. We then say the fives in 24 are 4 times, and 4 over. We write 4 under, and annex the 9 to the 4 over, and it makes 49, out of which we get 5 nine times and 4 over. We write the 9 under, and annex the 2 to the 4 over, and it makes 42; and thus we proceed as long as we have figures to be annexed. In the same manner every example is performed.

1. 5)749285
149857
5
749285

2. 11)6482794
589344 $\frac{10}{11}$
11
6482794

3. 7)4983642
35 { 5 { 711948-6 } 27
142389-3 } 35

4. Divide 496384 by 2, 4, 8
5. Divide 587664 by 3, 6, 12
6. Divide 741125 by 5, 7, 11
7. Divide 357428680 by 14
8. Divide 749684272 by 16

9. Divide 546789364 by 22
10. Divide 1943808741 by 27
11. Divide 37647104 by 56
12. Divide 233048552 by 88
13. Divide 28517856 by 96
14. Divide 622179063 by 99
15. Divide 266584392 by 108
16. Divide 687074058 by 121
17. Divide 458820384 by 132
18. Divide 786628752 by 144
19. Divide 116669817 by 81
20. Divide 147473534 by 120

SUPPLEMENT TO MULTIPLICATION AND DIVISION.

I. To multiply when the multiplier contains a fraction.

RULE. Multiply by the upper figure of the fraction, and divide the product by the under figure, to get the product of the fraction; then multiply as before, by the whole number, and to the product add that of the fraction.

1. Multiply 8427 by $4\frac{2}{3}$	2. 5672948 $9\frac{3}{4}$
3)16854	4)17018844
5618	4254711
33708	51056532
39326	55311243

3. Multiply 8426 by $4\frac{1}{2}$
4. Multiply 7938 by $6\frac{1}{3}$
5. Multiply 6275 by $5\frac{1}{5}$
6. Multiply 7592 by $12\frac{5}{8}$
7. Multiply 6437 by $10\frac{4}{9}$
8. Multiply 7432 by $14\frac{5}{12}$
9. Multiply 98764 by $38\frac{3}{7}$

10. Multiply 38976 by $127\frac{4}{11}$
11. Multiply 76548 by $476\frac{1}{13}$
12. Multiply 37968 by $295\frac{1}{18}$

II. To divide when the divisor contains a fraction.

RULE. Multiply both the dividend and the divisor by the under figure of the fraction, taking in the upper figure to the product of the divisor; then divide the products.

1. $4\frac{1}{2}$	738468	2. $8\frac{1}{4}$	689436
2	2	4	4
9	1476936	33	3 2757744
	164104		11 919248
			83568

3. Divide 2874126 by $7\frac{3}{4}$
4. Divide 34015404 by $23\frac{3}{7}$
5. Divide 67893284 by $29\frac{5}{6}$
6. Divide 85794361 by $11\frac{2}{3}$
7. Divide 87548679 by $42\frac{3}{8}$
8. Divide 72386748 by $55\frac{4}{11}$
9. Divide 87654869 by $24\frac{11}{12}$
10. Divide 87289654 by $38\frac{9}{17}$

REDUCTION.

Reduction is the method of converting a given number of one name into an equivalent number of another name.

I. To bring a number from a higher name to a lower.

RULE. Multiply by as many of the next lower name as make one of the given name, adding those of that lower if any be given, which will bring it to that lower name; then bring it in the same way to the next lower, and so on, till it is brought to the name required.

II. To bring a number from a lower name to a higher.

RULE. Divide by as many of the given name as make one of the next higher, and so on till it is brought to the name required.

NOTE. The remainders are always of the same name as their dividends.

PROOF. Bring back the number found by one of the rules to the given number by the other rule.

I. In £756, 12s. 11¾d, how many farthings?

£756, 12s. 11¾d.
20

15132 shillings.
12

181595 pence.
4

4)726383 farthings. Answer.

12)181595 ¾d.

2,0)1513,2 sh. 11¾d.

£756, 12s. 11¾d. Proof.

2. In £470, 10s. 11¾d., how many farthings?
3. In £385, 17s. 10½d., how many farthings?
4. In £200, 14s. 0¼d., how many farthings?
5. In £9, 17s. 6d., how many halfpence?
6. In 17s. 6½d., how many halfpence?
7. In 27846 farthings, how many pounds?
8. In 47209 farthings, how many pounds?
9. In 76548 farthings, how many pounds?
10. In 7482 halfpence, how many pounds?
11. In 9642 farthings, how many crowns?
12. In 764 guineas, how many farthings?
13. In 56748 farthings, how many guineas?
14. In 6742 half-guineas, how many three-pence
15. In 34 cr. 3½d., how many farthings?

16. In 7428 two-pence, how many guineas?
17. In 6247 half-crowns, how many halfpence?
18. In 95842 groats, each 4d., how many guineas?
19. In £856, 7s. 6d., how many half-crowns?
20. In 74869 half-crowns, how many pounds?

RULE III. When one of the names is not contained exactly in the other, reduce the given number by the first rule to a name which is contained exactly in that required; then by the second rule bring it to the name required.

21. In 748 guineas, how many pounds?
22. In 6742 crowns, how many guineas?
23. In 7428 half-crowns, how many shillings?
24. In 764 half-guineas, how many half-crowns?
25. In 874 guineas 18s. 4d., how many crowns?
26. In 854 joan., at 36s., how many £?
27. In 748 g., how many moid., at 27s.?
28. In £956, how many pounds Scotch, at 20d.?
29. In 56385 merks Scotch, at 13⅓d., how many crs.?
30. In 9756 half-crowns, how many moid.?
31. In 75646 dollars, at 4s. 6d., how many joannesses?
32. In 7564 merks Scotch, how many pounds Scotch?
33. In 9684 groats, how many half-crowns?
34. Reduce 9642 quarter-guineas to £.
35. Reduce £7548 to seven-shilling pieces.
36. Reduce £857 sterling, each 21s. 8d. Irish, to pounds Irish.
37. Reduce 9472 three-shil. pieces to pounds Scotch?

TROY WEIGHT.

38. In 758 lbs. troy, how many grains?
39. In 19 lb. 10 oz. 3 dwt. 11 grs., how many grains?
40. In 96748 grains, how many lbs. troy?
41. In 7492 dwt., how many lbs.?
42. In 18 lb. 12 dwt., how many grains?
43. In 11 oz. 19 grs., how many grains?
44. In 75482 grs., how many lbs.?
45. In 9628 dwt., how many lbs.?

APOTHECARIES' WEIGHT.

46. In 299 lbs., how many grs.?

47. In 784 lb. 6 dr. 2 scruples, how many grains
48. In 298 lbs. 1 scr., how many scruples?
49. In 854632 grains, how many lbs.?
50. In 7564 scr., how many oz.?
51. In 5678 drams, how many lbs.?

AVOIRDUPOIS WEIGHT.

52. In 56 ton, 7 cwt. 14 lb. 13 dr., how many drams?
53. In 34 cwt. 3 qrs. 11 oz., how many drams?
54. In 3 qrs. 14 oz. how many ounces?
55. In 27 lb. 10 drs., how many drams?
56. In 11 tons, 25 lb., how many ounces?
57. In 96842648 drams, how many tons?
58. In 7842858 ounces, how many tons?
59. In 64825 drams, how many lbs.?
60. In 84624 ounces, how many cwt.?
61. In 67528 drams, how many qrs.?

WOOL WEIGHT.

62. In 74 lasts wool, how many pounds?
63. In 954 sacks, 1 stone, how many pounds?
64. In 96842857 pounds, how many packs?
65. In 675428 cloves, how many lasts?

LINEAL MEASURE.

66. In 738 miles, how many inches?
67. In 7 miles, 5 fur. 14 po. 3 yds. 2 ft. 7 in., how many lines?
68. In 6472 miles, how many yards?
69. In 678425 feet, how many furlongs?
70. In 96842627 inches, how many miles?
71. In 957428 yards, how many miles?

YARN MEASURE.

72. In 12 spindles, 8 hanks cotton, how many threads?
73. In 46080 threads linen-yarn, how many spindles?
74. In 9684276 inches linen-yarn, how many hasps?
75. In 24 sp. cotton, how many feet?

CLOTH MEASURE.

76. In 748 yds. 3 qrs., how many nails?
77. In 472 yds. 2 qrs. 3 nls., how many inches?

78. In 87 yds. 3 qrs., how many half-nails
79. In 7482 nails, how many yards?
80. In 68472 inches, how many quarters?
81. In 784 yards, how many ells Flemish?
82. In 74962 ells English, how many ells French?
83. In 7592 ells French, how many ells Scotch?

SQUARE OR LAND MEASURE.

84. In 7486 acres, how many perches?
85. In 846 acres, 3 roods, 32 perches, how many square yards?
86. In 17 acres, 2 roods, 28 perches, how many square inches?
87. In 754862 perches, how many acres?
88. In 7428364 square yards, how many roods?
89. In 384 square yards, 7 square feet, 67 inches, how many inches?

CUBIC OR SOLID MEASURE.

90. In 243 cubic yards, how many cubic inches?
91. In 13856832 cubic inches, how many yards?
92. In 19 loads 25 feet rough timber, how many cubic feet?
93. In 9748 cubic feet of hewn timber, how many loads?
94. In 42574372 cubic inches, how many tons of shipping?

MEASURE OF CAPACITY.

95. In 73 quarters of wheat, how many pints?
96. In 47 qrs. 3 bush. 3 pec. 1 gal. 1 qt. 1 pt. how many pints?
97. In 68736 pts., how many quarts?
98. In 1184500 gal., how many cubic inches?

NOTE. Multiply by 277274, and divide by 1000, to bring gallons to inches, and the contrary to bring inches to gallons.

99. In 2036161619 cub. in., how many qrs.?
100. In 76824 qts., how many bushels?

OLD WINE MEASURE.

101. In 273 tuns, how many pints?
102. In 12 tuns, 3 hhd. 37 gall., how many pints?
103. In 67428 gall., how many puncheons?
104. In 56742 pints, how many tierces?

OLD ALE MEASURE.

105. In 7428 butts, how many quarts.
106. In 8246 barrels, how many tuns?
107. In 6542 firkins, how many pints?
108. In 742856 pottles, how many barrels?

OLD DRY MEASURE.

109. In 756 quarters, how many gallons?
110. In 52643 pecks, how many qrs.?
111. In 78 qrs. 3 bush. 2 pts., how many gallons?
112. In 7652 bushels, how many weys?

COAL MEASURE.

113. In 5 scores, 11 chaldrons, 5 sacks, how many bushels?
114. In 954826 bushels, how many chaldrons?
115. In 7528 sacks, how many scores?

TIME.

116. In 3 common years, 232 days, 13 hours, how many seconds?
117. In 7493684276 seconds, how many common years?
118. In 956 Julian years, how many thirds?
119. In 1826 Solar years, how many seconds?
120. In 749 months of 4 weeks, how many months of 30 days?
121. In 9684 moons of 29½ days, how many months of 4 weeks?
122. In 75462 moons of 29½ days, how many Julian years?
123. In 748 Solar years, how many moons of 29 days, 12 ho. 44 min..
124. How long would it require to count 900,000,000 of sovereigns, at the rate of 100 in a minute?

125. If a cannon-ball fly uniformly at the rate of 1000 feet per second, how many years would elapse before it reached Sirius, the nearest fixed star, supposing its distance 20 billions of miles?

COMPOUND ADDITION.

When the numbers to be added consist of more than one name, they are called compound.

RULE. Write the numbers to be added, so that those of the same name may stand under one another.

Add the numbers in the right-hand column, and find how often the sum contains the number of that name, which makes one of the next column, and write the remainder, if any, under the column, and carry the number of times to the next column.

Proceed in the same manner with all the other columns, till you come to the left-hand column, which is to be added as in simple addition.

PROOF. The same as in simple addition.

NOTE I. A farthing is expressed thus, ¼d.; a halfpenny thus, ½d.; and three farthings thus, ¾d.; Add the upper figures in farthings, and the under ones in halfpence.

NOTE II. When a name consists of two columns, both are to be added, and the sum divided as in the rule. If 20 is to be taken out of it, write the unit's figure, and divide the tens by 2, and if one remains, prefix it to the units. In like manner if 40 is to be taken out of it, divide the tens by 4, and so on.

1.	2.	3.	4.
£1 13 7¼	£0 0 7¼	£58 11 0	£9 7 6¼
0 7 8	0 15 0¾	6 10 11¼	10 19 10½
0 12 0½	1 10 11½	46 15 10½	11 18 9¾
8 0 11¾	16 16 6½	68 19 11¾	12 17 11¼
0 19 10½	85 14 10¾	93 8 7½	13 16 8¾
18 12 5¼	60 17 9¼	56 16 11¾	14 15 10¼

5.	6.	7.	8.
£98 17 7¼	£94 19 11¾	£66 16 6¼	£254 14 11¼
87 16 10½	70 16 10¼	78 19 10½	715 18 10½
76 19 11¾	59 17 9¼	89 13 9¾	916 15 5¾
65 16 9¾	47 18 8½	96 17 11¼	175 10 7¼
48 18 10¼	65 11 11¼	56 14 7¼	89 13 4½
73 13 7¼	88 17 5¼	83 18 10¾	7 19 7¾

9.	10.	11.	12.
£328 14 7½	£476 16 6½	£816 17 8½	£568 18 10½
800 17 5¼	567 18 8¼	389 10 10¼	374 16 10¼
407 12 8½	678 19 11¾	31 17 11	843 18 8¼
670 18 10¼	789 17 10¾	346 18 6½	276 13 7¾
598 10 10¾	890 15 4¼	407 13 8¾	751 11 9¼
742 18 11¼	910 13 3¾	748 11 11	208 10 11¼
967 17 11¼	678 18 11¼	567 14 4¾	540 19 3½
864 18 11¼	497 17 5¼	687 15 10¼	115 17 6¾

Troy Weight.

13.	14.
lb. oz. dw. gr.	*lb. oz. dw.*
54 10 18 17	71 7 15
63 11 16 21	89 10 16
78 9 17 22	57 11 18
9 10 14 12	63 9 17
91 7 16 23	78 7 17
27 8 18 17	17 11 10
48 10 9 19	28 6 17
56 6 17 20	31 9 19

Apothecaries' Weight.

15.	16.
lb. oz. dr. sc. gr.	*lb. oz. dr. sc. gr.*
67 7 6 2 16	216 10 7 2 17
36 8 7 1 18	168 11 4 1 18
93 10 5 0 14	345 9 5 0 14
16 11 7 2 12	468 10 3 2 13
27 9 2 2 19	507 8 6 0 10
38 8 6 1 17	473 9 2 1 8
42 6 6 1 19	549 6 7 2 14
57 10 4 2 13	184 11 3 0 19

Avoirdupois Weight.

17.	18.
ton. cw. qr lb.	*lb. oz. dr.*
47 13 2 15	18 10 12
76 14 3 23	17 11 14
84 15 1 21	26 9 10
27 16 2 27	23 14 13
86 13 3 25	25 15 9
94 17 1 21	6 14 15
49 18 2 24	22 10 12
17 10 1 16	16 15 10

19.	20.
oh. cw. qr. lb. o. dr.	*cw qr. lb. oz. dr.*
9 14 2 17 11 12	14 3 23 7 11
37 17 1 21 12 14	16 2 21 10 14
58 18 3 26 13 15	19 1 26 11 9
67 19 2 23 15 10	6 3 19 2 8
91 12 0 27 10 13	12 2 22 14 15
63 10 3 18 7 8	14 1 25 15 12
19 19 2 17 9 15	10 0 20 10 10
21 17 1 25 14 10	17 3 24 11 15

Lineal Measure.

21.	22.	23.	24.
y. f. in. lin.	*m. fu. po y.*	*m. fu. po. y. fe in.*	*m. fu. po.*
4 2 11 10	17 7 19 4	27 7 32 4 2 11	367 7 27
3 1 10 9	23 6 32 3	38 1 37 3 1 10	567 2 29
5 2 7 11	37 3 36 2	47 6 20 5 2 9	685 3 38
2 1 8 7	29 4 21 5	56 3 33 4 2 6	948 5 37
1 2 9 8	18 2 36 1	62 5 27 5 1 11	842 2 22
3 0 0 11	19 7 28 4	78 4 34 3 2 10	678 6 26
4 1 10 0	36 6 16 1	44 5 25 4 1 10	357 5 19
5 2 9 11	41 5 25 5	36 3 26 2 2 11	428 2 18

Cloth Measure.

25.				26.		
y.	*q.*	*n.*	*in.*	*y.*	*q.*	*n.*
17	3	2	2	62	2	3
18	2	3	1	57	1	2
27	1	3	1	63	3	0
84	2	2	2	45	0	3
33	0	3	1	76	3	2
16	2	0	2	80	2	2

Land Measure.

27.			28.						
ac.	*ro.*	*po.*	*ac.*	*r.*	*po.*	*y.*	*f.*	*in.*
21	3	31	79	3	27	13	6	72
19	2	2	83	2	23	14	8	83
36	3	19	91	1	33	25	7	91
57	1	38	16	3	22	29	8	99
61	2	37	31	1	37	30	3	42
77	3	39	55	3	23	27	7	56

Old Wine Measure.

29.				30.			
tun	*hhd.*	*g.*	*p.*	*hhd*	*g.*	*q.*	*p.*
75	3	25	4	78	37	3	1
86	2	36	6	19	54	2	0
79	1	53	7	25	56	1	1
65	0	44	5	84	62	2	1
16	2	60	2	70	30	0	0
33	3	13	4	68	47	3	1

Old Ale Measure.

31.				32.				
b.	*f.*	*g.*	*pt.*	*hhd.*	*bar.*	*f.*	*g.*	*q pt.*
17	3	5	7	68	1	3	7	2 1
29	2	7	5	76	0	2	4	3 0
31	1	6	4	85	0	1	6	1 1
47	2	4	6	31	1	2	5	2 1
71	3	6	5	57	0	3	3	1 1
77	1	7	6	44	1	3	6	3 1

Old Dry Measure.

33.						34.					
qr.	*bu.*	*p.*	*g.*	*qt.*	*pt.*	*qr.*	*co.*	*bu*	*p.*		
73	5	3	1	3	1	95	1	3	2		
68	6	2	0	2	1	53	1	2	3		
76	7	1	0	1	1	67	0	1	2		
48	4	3	1	0	0	72	1	0	3		
56	2	0	1	3	1	86	1	3	1		
29	6	2	0	2	1	91	0	2	2		

Time.

35.				36.			
y.	*da.*	*ho.*	*m.*	*da.*	*ho.*	*m.*	*se.*
79	162	18	38	167	10	41	51
54	241	19	41	761	13	36	47
67	98	17	53	567	19	59	33
86	195	20	47	93	12	24	37
65	318	21	58	86	14	31	43
76	78	18	35	57	21	44	55

Scots Weight

37.								
st.	*lb.*	*oz.*	*dr.*					
76	10	12	13					
55	14	10	9					
38	12	11	7					
56	13	14	15					
74	7	8	14					
19	8	12	11					

Land Meas.

38.								
ac.	*ro.*	*fa*	*ell.*					
67	3	13	14					
19	2	24	28					
16	1	19	17					
12	3	23	34					
21	0	37	35					
34	3	33	32					

Liquid Measure

39.								
b.	*g.*	*q.*	*p.*	*c.*	*m.*	*g.*		
13	7	3	1	0	1	3		
17	6	2	1	1	0	2		
18	4	1	0	1	1	1		
19	5	3	1	0	1	2		
17	5	2	1	1	0	3		
19	7	3	1	1	1	2		

Dry Meas.

40.								
ch.bo	*fir.pe.li*							
67	14	3	2	3				
96	13	2	3	2				
57	12	1	1	3				
68	15	2	0	3				
76	10	3	3	0				
85	11	1	2	3				

COMPOUND SUBTRACTION.

RULE. Write the numbers so that like names come under like.

Subtract the lowest name of the less line from the same name of the greater, and write the remainder under it.

But if the number of the less line is greater than the other, subtract it from the number of that name which makes one of the next higher, and to the remainder add the number of the greater, and write the sum under it, and carry one to the next higher name of the less line.

Do the same with the next higher name, and so on till the whole is subtracted.

PROOF. As in simple subtraction.

	1.			2.			3.			4.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
From	73	14	$5\frac{3}{4}$	89	11	$7\frac{1}{4}$	23	13	$3\frac{1}{4}$	12	7	$6\frac{1}{2}$
Take	38	12	$2\frac{1}{4}$	42	14	$4\frac{1}{2}$	17	14	$5\frac{3}{4}$	9	8	$8\frac{3}{4}$

	5.			6.			7.			8.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
	296	3	$8\frac{1}{2}$	314	10	$4\frac{1}{2}$	478	9	$8\frac{1}{2}$	560	15	$5\frac{1}{2}$
	172	12	$7\frac{3}{4}$	275	14	$5\frac{1}{2}$	258	18	$8\frac{1}{2}$	309	14	$6\frac{3}{4}$

	9.			10.			11.			12.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
	671	3	11	409	0	4	190	10	$1\frac{3}{4}$	715	14	0
	456	18	$10\frac{1}{2}$	268	7	$4\frac{1}{2}$	96	14	$0\frac{3}{4}$	620	15	$6\frac{3}{4}$

Troy Weight.

	13.			14.					*Apothecaries' Weight.* 15.					16.				
	lb.	*oz.*	*dw.*	*lb.*	*oz.*	*dwt.*	*gr.*		*oz.*	*dr.*	*sc.*	*gr.*		*lb.*	*oz.*	*dr.*	*sc.*	*gr.*
	57	7	13	40	6	3	10		9	3	1	7		9	3	0	0	0
	38	8	18	37	6	8	18		6	4	2	12		3	8	5	0	18

Avoirdupois Weight.

	17.			18.				19.				20.			
	lb.	*oz.*	*dr.*	*cwt.*	*qr.*	*lb.*		*ton.*	*cwt.*	*qr.*	*lb.*	*ton.*	*cw.*	*qr.*	*lb.*	*oz.*	*dr.*
	22	10	5	18	1	11		42	11	1	18	136	11	1	10	7	8
	13	14	15	9	3	22		27	16	3	23	97	14	1	21	11	12

Long Measure.

	21.				22.						*Cloth Measure.* 23.				24.		
	y.	*f.*	*in.*	*lin.*	*m.*	*fu.*	*po.*	*y.*	*f.*	*in.*	*yd.*	*qr.*	*nl.*	*in.*	*yd.*	*qr.*	*na.*
	16	1	3	4	824	0	12	3	2	6	27	2	1	1	76	0	3
	9	2	10	9	386	7	32	4	2	10	18	3	2	2	47	2	2

Land Measure.									*Scotch Land Measure.*							
25.				26.					27.				28.			
ac.	*ro.*	*pe.*	*y.*	*ac.*	*ro.*	*pe.*	*y.*	*fe. in.*	*ac*	*ro.*	*fa.*	*el.*	*ac.*	*ro.*	*fa.*	*el.*
56	2	25	14	7	3	18	7	2 39	46	2	24	18	57	0	30	3
48	3	38	18	4	3	27	11	3 120	26	3	27	32	43	2	33	16

Old Wine Measure.								*Old Dry Measure.*							
29.				30.				31.				32.			
hd.	*ga.*	*qt.*	*pt.*	*tun.*	*hhd.*	*gal.*	*pt.*	*qr.*	*bu.*	*pe.*	*g.*	*qr.*	*bu.*	*pe.*	*g.*	*qt.*	*p.*
56	42	2	0	76	2	28	3	126	2	1	0	67	3	1	0	2	0
28	53	3	1	27	3	42	5	94	3	3	1	48	4	3	1	3	1

Time

33.				34.					35.				
da.	*ho.*	*m.*	*sec.*	*we.*	*da.*	*ho.*	*m.*	*sec.*	*y.*	*da.*	*ho.*	*m.*	*sec.*
176	10	11	34	40	3	12	0	19	256	172	16	23	34
87	14	28	56	18	6	16	56	20	197	348	18	42	24

COMPOUND MULTIPLICATION.

RULE I. When the multiplier is not greater than 12, multiply the lowest name of the multiplicand by the multiplier, and find, as in addition, how many are to be carried to the next name, writing the remainder under the lowest; then multiply the next name, and add the carriage to the product, and proceed with it as before, and so on till all the names are multiplied.

PROOF. Multiply separately by any two figures of which the sum is the multiplier, and add the products

Multiply	£35	17	$8\frac{3}{4}$	£35	17	$8\frac{3}{4}$	1 × 116 cw.	3 qr.	19lb
by			7			6			9
Product	£251	4	$1\frac{1}{4}$	215	6	$4\frac{1}{2}$	62	1	3
				35	17	$8\frac{3}{4}$			
Proof	£251	4	$1\frac{1}{4}$						

1. Multiply £14 6s. 7½d. by 7
2. Multiply 9 8 4¼ by 8
3. Multiply 74 18 11½ by 9
4. Multiply 18 0 11¾ by 10
5. Multiply 17 8 0¾ by 5
6. Multiply 4 6 7½ by 6
7. Multiply 0 9 4¼ by 12
8. Multiply 70 0 11½ by 11
9. Multiply 19 13 7¾ by 4
10. Multiply 18 0 4¼ by 3
11. Multiply 7 cw. 2 qr. 18 lb. by 9
12. Multiply 15 lb. 13 oz. 8 dr. by 11
13. Mult. 18lb. 3oz. 14dw. 13gr. by 12
14. Multiply 7 bu. 3 pe. 1g. 2.p. by 3
15. Multiply 8 ac. 2 ro. 14 pe. by 8
16. Multiply 4 hhd. 19 ga. 3 pt. by 11

RULE II. When the multiplier is the product of two numbers, neither of which is greater than 12, multiply first by one of these numbers, and the product by the other.

Multiply £4, 13s. 9¼d.				Multiply £1, 18s. 9¾d.			
by 56=8×7			8	by 84=12×7			12
	37	10	2		23	5	9
			7				7
Product	£262	11	2	Product	£163	0	3

1. Multiply £3, 14s. 4½d. by 14
2. Multiply 7 3 10¼ by 15
3. Multiply 12 13 0¾ by 21
4. Multiply 35 0 7¼ by 22
5. Multiply 23 15 0¾ by 24
6. Multiply 13 17 1½ by 35
7. Multiply 9 8 10¾ by 27
8. Multiply 13 11 5½ by 42
9. Multiply 0 17 11¾ by 56
10. Multiply 1 15 5¼ by 77
11. Multiply 4 5 3¼ by 84

12. Multiply £8 7 7¼ by 108
13. Multiply 8 lb. 7 oz. 13 dr. by 110
14. Multiply 5 da. 17 h. 37 m. by 121
15. Multiply 6 cw. 2 q. 17 lb. by 63
16. Multiply 3 ac. 2 ro. 21 po. by 88

RULE III. When the multiplier is not the product of two numbers, take the nearest product, and multiply by its factors, then multiply the multiplicand by the difference between the assumed product and the given multiplier, and add the products when the assumed number is less than the given multiplier; otherwise subtract them.

Multiply	£2 7 8¼ × 2	Multiply	*ac.ro per.* 2 3 12 × 3
by 68 = 6 × 11 + 2	6	by 117 = 10 × 12 − 3	10
	14 6 1½		28 1 0
	11		12
66 times	157 7 4½	120 times	339 0 0
2 times	4 15 4½	3 times	8 1 36
Product	162 2 9	117 times	330 2 4

1. Multiply £3, 7s. 0¼d. by 17
2. Multiply 4 0 3½ by 23
3. Multiply 7 0 0¾ by 43
4. Multiply 18 11 4 by 53
5. Multiply 7 18 0¼ by 59
6. Multiply 18 19 7 by 74
7. Multiply 37 12 3¾ by 79
8. Multiply 27 14 5¼ by 103
9. Multiply 7cw. 2q. 14lb. by 94
10. Multiply 2m. 5fu. 17po. by 123
11. Multiply 17hd. 3gal. 4p. by 147
12. Multiply 5d. 17h. 44m. by 137

RULE IV. When the multiplier is large, multiply successively by 10, till the multiplicand and the products make as many lines as there are figures in the multiplier; then multiply the multiplicand by the right-hand figure

of the multiplier, the first product by the second figure, the next by the third, and so on. Lastly, add the products thus obtained.

Multiply £3, 14s. $8\frac{3}{4}$d. $\times 3 =$ 11 4 $2\frac{1}{4}$ = 3 times
by 9753
10

37 7 $3\frac{1}{2}$ $\times 5 =$ 186 16 $5\frac{1}{4}$ = 50 times.
10

373 12 11 $\times 7 =$ 2615 10 5 = 700 times
10

£3736 9 2 $\times 9 =$ 33628 2 6 = 9000 times

Total product £36241 13 $6\frac{3}{4}$

1. Multiply £7, 13s. $7\frac{1}{2}$d. by 348
2. Multiply 6 3 $8\frac{3}{4}$ by 703
3. Multiply 1 5 $0\frac{1}{2}$ by 7081
4. Multiply 6 7 $8\frac{1}{4}$ by 9008
5. Multiply 2 8 $7\frac{3}{4}$ by 9420
6. Multiply 3 12 $4\frac{1}{4}$ by 6905

COMPOUND DIVISION.

RULE I. Place the divisor on the left of the dividend, and divide the highest name as in simple division; then reduce the remainder to the next lower name, taking in the given number of that name, if any; divide again to get the next part of the quotient, and so on to the lowest name.

PROOF. Multiply the quotient by the divisor, and add the remainder, if any, to the product.

1. 87)£4561, 15s. 9¾d.(£52, 8s. 8¼d.×1
435 8

211 419 9 6
174 11

37 4614 4 6
20 —52 8 8¼

755 Proof 4561 15 9¾
696

59
12

717
696

21
4

87

2. Divide £17, 1s. 7¾d. by 31
3. Divide 578 18 8¼ by 82
4. Divide 418 13 4 by 65
5. Divide 1118 13 6 by 98
6. Divide 567 16 6 by 98
7. Divide 986 15 5 by 112
8. Divide 6954 14 4 by 378
9. Divide 5139 16 8 by 1815
10. Divide 207 19 8½ by 231
11. Divide 789 18 6½ by 365
12. Divide 1287 13 4¾ by 499
13. Divide 5486 12 9¼ by 1763
14. Divide 476 lb. 4 oz. 20 grs. by 275
15. Divide 482 cwt. 2 qrs. 18 lbs. by 318
16. Divide 894 ac. 3 ro. 28 per. by 89

RULE II. When the divisor does not exceed 12, divide

and reduce mentally, placing the quotients under the dividend; and when the divisor is the product of two numbers, neither of which exceeds 12, divide in the same manner, first by one of them and the quotient by the other.

1. $36 \left\{ \begin{array}{l} 4 \\ 9 \end{array} \right.$ £141 1 $7\frac{1}{4}$ by 36

35 5 $4\frac{3}{4}$—1 } R. S.

£3 18 $4\frac{1}{2}$—1 }

2. Divide £798, 15s. 6d. by 5
3. Divide 195 15 $2\frac{1}{4}$ by 9
4. Divide 73 17 8 by 11
5. Divide 17 1 7 by 12
6. Divide 75 12 0 by 84
7. Divide 93 16 $10\frac{1}{2}$ by 99
8. Divide 102 10 $6\frac{3}{4}$ by 108
9. Divide 636 16 9 by 132
10. Divide 484 15 $8\frac{1}{4}$ by 88
11. Divide 487 16 $10\frac{1}{2}$ by 64
12. Divide 375 11 6 by 45
13. Divide 892 10 $9\frac{3}{4}$ by 63
14. Divide 2389 16 $8\frac{1}{2}$ by 96
15. Divide 7480 11 $2\frac{3}{4}$ by 81
16. Divide 5480 12 $10\frac{1}{4}$ by 56

RULE III. When the divisor is like the dividend, reduce them both to the lowest name mentioned, and proceed as in simple division; the quotient shows how often the less is contained in the greater.

NOTE. In simple division the dividend and divisor are both abstract numbers, and the quotient shows how often the latter can be taken out of the former; and the same idea is to be formed of the work when the given numbers are of the same kind, though in different names.

Divide £159 5s. 3d. by 7s. 9d.

20

7s. 9d 3185

12 12

93)38223(411 quotient.

372

102

93

93

1. Divide £447, 7s. 10½d. by £4, 3s. 7½d.
2. Divide 87 6 8 by 1 7 3½
3. Divide 16 19 0¾ by 0 1 6¾
4. Divide 987 6 7 by 2 3 11¾

SUPPLEMENT TO COMPOUND MULTIPLICATION AND DIVISION.

When the number, by which it is required to multiply or divide, contains a fraction, work as in the supplement to simple multiplication and division.

1. Mult. £7, 3s. 5½d. by 4½

3 11 8¾

28 13 10

32 5 6¾

2. 9⅕)£56, 18s. 10½d.

5 5

48 { 6|284 14 4½ ; 8|47 9 0¾–0 ; 5 18 7½–3 } 1⅝

3. Multiply £5, 14s. 8d. by 3¼
4. Multiply 1 16 6 by 22⅔
5. Multiply 27 18 7½ by 17⅝
6. Multiply 38 19 10½ by 29⅞
7. Multiply 45 13 6¾ by 38⅗
8. Multiply 24 lb. 5 oz. 15 d. by 27⅔
9. Multiply 49 ac. 2 r. 36 p. by 87⅚

10. Multiply 6 cwt. 3 qr. 17 lb. by $5\frac{1}{8}$
11. Divide £86, 18s. $10\frac{1}{3}$d. by $9\frac{3}{5}$
12. Divide 30 2 $10\frac{1}{2}$ by $22\frac{3}{4}$
13. Divide 876 11 $9\frac{3}{4}$ by $35\frac{1}{8}$
14. Divide 726 10 $10\frac{1}{4}$ by $87\frac{3}{4}$
15. Divide 45 19 $11\frac{1}{2}$ by $94\frac{2}{11}$
16. Divide 34 lb. 5 oz. 18 g. by $46\frac{5}{13}$
17. Divide 47 m. 3 f. 19 po. by $55\frac{7}{9}$
18. Divide 23 cw. 3 qr. 18 lb. by $6\frac{4}{7}$

APPLICATION OF THE PRECEDING RULES TO PRACTICE.

Every thing to which arithmetic can be applied is performed by these rules, but here we take notice only of such things as each can accomplish by itself.

USES OF ADDITION.

I. When I have received or given away several sums of money, or several quantities of goods, and wish to know how much I have received or given altogether.

RULE. Add together all the money or all the quantities of goods, and the sum will show how much is received or given in all.

II. When the contiguous intervals of space or time between several places or events are given, to find the interval between the extremes.

RULE. Add all the intervals; the sum will be the interval between the extreme places or events.

III. When the number, value, or measure of sever different parcels is given, to find the value of them all.

RULE. Add them all together.

1. I received from A £435, 16s., from B £87, 12s. $8\frac{1}{2}$d., from C £198, 3s., 6d., from D £648, 8s. $8\frac{1}{2}$d., and from E £38, 18s.; how much have I received?

2. A merchant owes to F £226, 17s. 7d., to G £324, 14s., to H £93, 13s., to K £129, 19s. 9d., and to L £19, 19s. 9½d.; what is his debt?

3. A debtor paid to M £486, 18s. 9d., to N £345, 11s. 4½d., to P £179, to Q £527, 16s. 4¾d., to R £178, 18s. 8¾d.; how much did he pay in all?

4. An estate consists of six farms; the first is rented at £520, 10s., the second at £472, 18s., the third at £648, 18s., the fourth at £375, 12s. 6d., the fifth at £284, 17s. 6d., and the sixth at £174, 18s. 9d.; what is the rent of the estate?

5. A workman earned on Monday 4s. 7d., on Tuesday 3s. 10d., on Wednesday 5s. 4d., on Thursday 2s. 6d., on Friday 6s. 2d., and on Saturday 3s. 8d.; what did his week's wages amount to?

6. A merchant imported grain which lay in his granary nine months, the original price was £1250, the freight £320, premium of insurance £38, 10s. 6d., expenses at landing £13, 14s. 6d., rent £87, 12s. 6d., other expenses £75, 19s. 9d., loss of interest £43, 17s. 8d.; what did it cost him in all?

7. My house-rent is £50, land-tax £5, house-duty £7, 1s. 8d., window-tax £2, 3s. 9d., police-tax £4, 3s. 6d., poor's rates £3, 2s. 6d., water and town-charges £2, 11s. 6d.; what is the amount of my rent and taxes?

8. A gentleman owes his wine-merchant £74, 16s. 8d., confectioner £14, 16s. 8d., draper £48, 18s., tailor £35, 16s, 6d., coachmaker £136, 10s., tallow-chandler £7, 16s. 4d., corn-chandler, £93, 19s. 9d., brewer £46, 18s., butcher £78, 18s. 3d., baker £35, 15s. 10d., and servants' wages £45, 18s.; how much money will be required to pay the accounts?

9. A merchant has in the bank £99, 14s., broad cloth valued at £648, 14s. 8d., narrow cloth £528, 19s. 6d., serges £27, 18s. 9d., flannels £98, 18s. 4d., worsted stockings £129, 15s. 4d., silk stockings £136, 13s. 2d., hats £147, 15s. 5d., debts owing him, £754, 19s. 6d., what is the value of his stock?

10. The freights received for a voyage were, from John

Cairns, £42, 14s. 8d., from William Smith £28, 18s. 3½d., from James Watt £19, 17s. 11½d., from Robert Allan £18, 18s. 5d., from Alexander Bruce £35, 15s. 3d., and from David Hume £48, 18s. 7d.; what did the freight amount to?

11. A merchant owes the following bills; viz. to James Waters £356, interest on it £17, 8s. 9d., to Walter Scott £520, with interest £19, 7s. 6d., to Peter Fraser £386, 16s., interest £11, 11s. 11d., to Charles Hood £756, interest £21, 11s. 7d., to Howat and Smith £635, 5s., interest £8, 11s. 7d., to Thomas Weir £596; how much money will pay his bills?

12. The duties upon imports in the year 1814, were £23,468, 13s. 8d.; in 1815—£25,793; in 1816—£27,954, 11s. 6d.; in 1817—£30,168, 18s. 8d.; in 1818—£33,648, 18s. 7d.; in 1819—£31,576, 17s. 6d., and in 1820—£29,179, 18s. 9d.; what did the duties amount to?

13. The imports into Britain for one year were, from Sweden £253,280, from Russia £967,339, from Spain £594,893, from Portugal £359,127, from Holland £493,944, from France £672,478, from Germany £1,085,107, from the Mediterranean £2,176,614; what did the imports from Europe amount to?

14. The sums deposited in the bank on a merchant's account were, on the 1st day of the month, £542, 12s., on the 5th day £326, 16s., on the 12th £624, on the 18th £267, 17s. 4d., on the 23d £97, 14s, on the 26th, £137, 19s., on the 30th £385, 18s. 8d.; how much was he credited for at the bank in that month?

15. A ship's cargo consisted of 8 hhds., which weighed 4 tons 13 cwt. 1 lb., of 8 barrels, weighing 3 tons 4 cwt. 2 qr. 12 lb., of 6 boxes, weighing 10 cwt. 3 qr. 3 lb., of 16 bales, weighing 2 tons 15 cwt. 19 lb., also of 30 tons hemp, of 5 tons 14 cwt. 3 qr. 17 lb. flax, and of 27 tons 18 cwt. 1 qr. 24 lb. iron; what was the ship's burden?

16. The produce of a sugar plantation was, in the first year, 34 tons 7 cwt. 3 qr. 27 lb., next year it was 47 tons 18 cwt. 1 qr. 26 lb. 13 oz. 15 dr., in the third year

21 tons 16 cwt. 2 qr. 24 lb. 14 oz. 13 dr., in the fourth year 44 tons 11 cwt. 1 qr. 25 lb. 13 oz. 15 dr., and in the fifth year 32 tons 8 cwt. 3 qr. 27 lb. 13 oz. 14 dr.; what was the total produce?

17. What is the weight of 6 bales of cotton, No. 1, 2 cwt. 2 qr. 17 lb., No. 2, 2 cwt. 3 qr. 1 lb., No. 3, 2 cwt. 2 qr. 22 lb., No. 4, 2 cwt. 3 qr. 17 lb., No. 5, 2 cwt. 2 qr. 25 lb., and No 6, 2 cwt. 3 qr. 17 lb?

18. A merchant made up seven parcels of tea; the first weighed 8 lb. 9 oz. 10 drs., the second 19 lb. 7 oz. 4 dr., the third 22 lb. 13 oz. 8 dr., the fourth 18 lb. 9 oz. 4 dr., the fifth 22 lb. 10 oz. 12 dr., the sixth 14 lb. 14 oz., and the seventh 17 lb. 15 oz. 10 dr.; what was the weight of the whole?

19. A gentleman's silver plate weighs as follows; viz, dishes and covers 48 lb. 7 oz. 14 dw. 20 gr., plates 63 lb. 3 oz. 13 dw. 18 gr., spoons and ladles 26 lb. 4 oz. 14 dw. 19 gr., a tea-pot 4 lb. 8 oz. 10 dw. 12 gr., salts 3 lbs., 0 oz. 0 dw. 16 gr., trays 8 lb. 4 oz. 0 dw. 10 gr., tankards 13 lb. 3 oz. 0 dw. 19 gr., candlesticks 22 lb. 0 oz. 17 dw., and smaller articles 36 lb. 10 oz. 13 dw. 21 gr.; what was its total weight?

20. A draper has in his shop, of blue cloth, 456 y. 3 q. 2 na., of blacks 386 y. 3 q. 3 na., browns 648 y. 2 q. 2 na., scarlets 139 y. 3 q. 1 na., mixtures, 758 y., and of other colours 827 y. 3 q.; how much has he in all?

21. The quantity of linen exported from Ireland to America, was, in the year 1798—2,361,483 yards; in 1799—1,376,382 yards.; in 1800—1,156,467 yards; in 1801—2,519,575 yards; in 1802—1,089,223 yards; how much was exported in these five years?

22. From London to Hatfield is 20 m. 1 fur. 14 po. 3 yds., thence to Biggleswade 26 m. 1 fur. 4 po. 2½ yards, thence to Stilton 30 m. 19 po., thence to Colesworth 28 m. 15 p. 3 yds., thence to Newark 22 m. 1 fu. 2 p. 1 y., thence to Doncaster 37 m. 1 fur. 7 po. 2 yds., thence to York 37 m. 12 po. 1 yd.; Required the distance between London and York?

23. A gentleman enclosed five fields, and found that

the length of the wall surrounding the first was 2 fur. 18 po. 5 yds, the second 3 fur. 22 po. 3 yds., the third 1 fur. 30 po. 4 yds., the fourth 4 fur. 25 po. 3 yds., and the fifth 2 fur. 36 po. 5 y.; what length of wall was required to enclose the whole?

24. A farm consisted of five fields, the first measured 24 ac. 3 ro. 37 pe., the second 18 ac. 2 ro. 19 p., the third 27 ac. 1 ro. 12 p., the fourth 15 ac. 3 ro. 32 p., and the fifth 21 ac. 2 ro. 25 p.; how many acres were in the farm?

25. An estate consisted of eight farms; the first measured 246 ac. 3 ro. 17 per.; the 2d, 394 ac. 2 ro. 20 p. 14 yds.; the 3d, 560 ac. 2 ro. 18 per. 22 yds.; the 4th, 276 ac. 3 ro. 0 per. 17 yds.; the 5th, 468 ac. 0 ro. 17 per. 12 yds.; the 6th, 640 ac.; the 7th, 375 ac. 3 ro. 12 per. 10 yds.; and the 8th, 427 ac. 1 ro. 36 per. 25 yds.; what does the estate measure?

26. A distiller sold on Monday 4 tuns 2 hhd. 36 gal., on Tuesday 3 tuns 3 hhd. 30 gal., on Wednesday 5 tuns 1 hhd. 45 gal., on Thursday 7 tuns 3 hhd. 56 gal., on Friday 6 tuns 2 hhd. 27 gal., and on Saturday 8 tuns 3 hhd. 48 gal.; the hhd. held 63 gal., and the tun 4 hhd.; how much did he sell during the week?

27. A brewer sent to his customers at one time 4 tuns 5 bar. 22 gal., at another 5 tons 4 bar. 30 gal., at a 3d, 3 tuns 3 bar. 9 gal., at a 4th, 6 tuns 6 bar. 13 gal., at a 5th, 4 tuns 5 bar. 30 gal., and at a 6th, 2 tuns 3 bar. 21 gal., each barrel containing 36 gallons, and a tun 6 barrels; how much did he send in all?

28. A merchant imports 486 qrs. 5 bu. 3 pk. wheat, 372 qrs. 5 b. 2 p. barley, 764 qrs. 6 bu. 1 p. oats, 257 qrs. 3 bu. pease, 126 qrs. 3 p. beans, 193 qrs. 2 bu. 3 p. rye; how much grain has he to pay freight for?

29. A man who engaged to perform six pieces of work; finished the 1st in 32 da. 10 ho. 35 m., the 2d, in 26 da. 15 h. 44 min., the 3d in 19 da. 11 ho. 38 m., the 4th in 34 da. 50 m., the 5th in 21 da. 18 h., and the 6th in 64 da. 16 h. 15 m.; in what time did he execute the whole?

USES OF SUBTRACTION.

I. When I receive money or goods, and afterwards dispose of part of them, and then wish to know how much I have on hand.

RULE. Subtract what was disposed of from what was received.

NOTE. When several quantities are received or several given away, add them together before the subtraction.

II. When I know the intervals between one place or event, and two others on the same side of it, and want to find the interval between these two.

RULE. Subtract the less of the given intervals from the greater.

1. Borrowed £473, 9s. 4d., and paid in part £286, 16s. 8½d.; what is still due?

2. Lent 100 guineas, and received back £42, 18s. 6d.; how much is due?

3. I borrowed £856, 14s. 6d., but have since paid, at one time, £236, 16s. 3d., at another £178, 14s., at a third £97, 15s. 10d., and at a fourth £226, 16s.; what is still owing?

4. A merchant has in money £147, 16s. 4d., goods valued at £1264, 14s. 6d., and a house at £742, 16s. At the same time he owes to A £254, 15s. 8d., to B £386, 16s., to C £89, 17s. 4d., and to D £568, 17s. 9d.; required his net stock?

5. A gentleman's annual income is £486, 18s. 4d., his household expenses amount to £196, 14s. 8½d., his rent £65, 16s., taxes £14, 16s. 6d., servants' wages £56, 18s. 6d., tradesmen's accounts, £42, 13s. 3d., and incidental expenses £14, 10s.; how much does he save?

6. A borrowed from B, at first, £794, 14s., and afterwards £577, 11s. 6d., but he has since paid him in goods £187, 18s. 4d., by a draft on C £200, and in cash £463, 18s. 9d.; how much does he still owe him?

7. A bankrupt owed to one of his creditors £956, 14s. 6d, to another £842, 19s. 3d., to a third £636, 9s. 5d.,

to a fourth £255, 15s. 7d., and to a fifth £369, 11s. 3d. His goods were valued at, cloth £213, 18s., linen £318, 17s. 7d., tea £175, 16s. 10d., wine £78, 12s., debts owing to him £523, 12s., furniture £197, 11s. 2d.; required a state of his affairs?

8. A gentleman's estate came to £25,000, and he left £2000 to each of his three daughters, and £4000 to each of his two younger sons, and the rest to the eldest son; what was his portion?

9. Required the net proceeds of two bills discounted at the bank; the amount of the one bill was £254, and that of the other £240; the discount on the former was £3, 1s. 8d., and on the latter £2, 17s. 5d.?

10. A silversmith bought 89 lb. 6 oz. 16 dw. 3 grs. of silver, of which he made 21 lb. 10 dw. into tea-spoons, 31 lb, 18 grs. into table-spoons, 12 lb. 11 oz. 2 dw. 4 grs. into tea-pots, and sold 24 lb. 6 oz. 6 dw. 17 gr.; how much has he remaining?

11. A merchant bought 14 cw, 2 qr. 20 lb. of sugar, of which he sold, at one time, 2 cwt. 13 lb., at another 1 cw. 2 qrs. 18 lb. 15 dr., at a third, 3 cw. 3 qrs. 27 lb. 15 oz., at a fourth, 3 qrs. 17 lb. 12 dr., at a fifth, 23 lb. 15 dr., at a sixth, 15 lb. 13 oz. 14 dr., at a seventh, 17 lb. 11 oz. 13 dr., and at an eighth, 2 cw. 16 lb. 11 oz. 12 dr.; how much has he on hand?

12. Required the net weight of 4 hhds. tobacco, No. 1, 7 cw. 2 qrs., tare 2 qrs. 5 lb., No. 2, 6 cw. 3 qr., tare 3 qr. 9 lb., No. 3, 5 cw. 3 qrs. 4 lb., tare 3 qrs. 14 lb., No. 4, 8 cw. 2 qrs. 16 lb., tare 2 qrs. 3 lb.?

13. A piece of silk measured 42 yds. 3 qrs., and there were sold of it at different times 10 yd. 3 qr. 3 nails,—9 yd. 2 qr. 2 nails,—12 yd. 1 qr. 3 nails; how much remained?

14. From London to Edinburgh is 398 m. 3 fur. 20 p., and from London to York 200 m. 5 fur. 35 po.; how far is York from Edinburgh?

15. A gentleman's estate measures 3465 acres, and he has let of it to A 463 ac. 3 ro. 14 po., to B 643 ac. 3 ro. 14 po., to C 713 ac. 1 ro. 17 po., to D 831 ac. 37 p.,

and to E 547 ac. 38 po.; how much remains in his own hands?

16. A man set out upon a journey of 256 m. 5 fur. 36 p., and travelled the first day 32 mil. 4 fur. 18 po., the second 35 mil. 2 fur. 22 pol., the third 38 mil. 5 fur. 26 po., the fourth 29 mil. 3 fur. 16 pol., the fifth 39 m. 24 p., and the sixth 36 m. 5 f.; how far is he from the end of his journey?

17. From a log which measured 83 cubic feet, 427 in. a piece was cut off which measured 37 cub. ft. 983 in.; how much remained?

18. A merchant had 347 hhds. 41 gal. wine, reckoning 63 gal. to the hhd., and he sold of it, at one time, 13 hhd 8 ga. 7 pt., at another 44 h. 47 g. 3 p., at a third 45 h. 62 g. 7 p., a fourth 57 h. 13 g. 6 p., a fifth 45 h. 12 g. 4 p., a sixth 34 h. 18 g. 5 p.; what quantity remained unsold?

19. A brewer had in his cellar 296 barrels of beer, each containing 36 gals., of which he sent to his customers as follows: viz. to A 25 bar. 33 g. 5 p., to B 16 bar. 3 g. 4 p., to C 31 b. 31 g. 4 p., to D. 34 bar. 32 g. 3 p., to E. 18 b. 18 g. 3 p., and to F. 23 b. 33 g. 7 pt.; how much remained in his cellar?

20. A minister's stipend in Scotland, besides money, consists of 5 chalders, 7 bolls, 3 firlots of oats, and 1 chalder, 10 bolls, 2 firlots of barley, of which one heritor paid 9 bolls, 3 fir. 3 pe. of oats, and 5 b. 2 f. 2 p. 1 lip. of barley; another paid 10 b. 2 f. 2 p. 2 l. of oats, and 4 b. 3 f. 3 l. of barley; a third 12 b. 3 f. 3 l. of oats, and 3 b. 3 p. of barley, a fourth 13 b. 3 p. of oats, and 4 b. 2 f. 3 p. of barley; a fifth 15 b. 2 f. 2 p. 3 l. of oats, and 3 bolls of barley; the principal heritor paid the rest; how much was he taxed?

21. The same stipend, when reduced to imperial standard measure, came to 63 qr. 3 bus. 1 gal. 3 qt. 1 pt. of oats, and 19 qrs. 1 bus. 1 gal. 2 qts. of barley; of which the first heritor paid 7 qr. 1 bus. 1 p. 1 gal. 2 qts. of oats, and 4 qrs. 2 pec. 3 qts. 1 pt. of barley; the second 7 qrs. 5 bu. 2 pec. 3 qts. of oats, and 3 qrs. 3 bus.

2 pec. 1 gal. 3 qts. 1 pt. of barley; the third 9 qrs. 1 bus. 3 pec. 1 gal. 3 qts. of oats, and 2 qrs. 2 b. 1 pec. 1 gal. 1 qt. 1 pt. of barley; the fourth 9 qrs. 4 bu. 1 gal. 3 qts. 1 pt. of oats, and 3 qrs. 3 bu. 3 qts. of barley; and the fifth 11 qrs. 2 bu. 2 p. 3 qts. of oats, and 2 qrs. 1 bus. 1 pec. 3 qts. of barley; how much did the principal heritor pay?

22. An apprentice, who was bound for 7 years, has already completed 3 yrs. 9 m. 2 we. 5 da. of his time; how long has he yet to serve, reckoning 13 months of 4 weeks to the year?

23. A was 16 years o'd when B was born; how old will B be when A is 49, and how old will A be when B is 56?

24. A man was born on the 23d of September, 1756, and died on the 18th May, 1825; how long did he live, reckoning 365 da. to a year, but adding 17 days to his age for leap years?

25. The latitude of the North Cape is 71° 10′ N., and that of Gibraltar is 36° 6′ 30″ N.; required the difference of latitude?

USES OF MULTIPLICATION.

I. When the value, weight, measure, &c. of one article is given, to find the value, &c. of any number of articles.

RULE. Multiply by the number of articles.

II. To find the amount of wages, provisions, or of any thing which is increased by length of time.

RULE. Multiply by the time.

What is the value of

1. 12 yards at £1, 7s. 6d. per yd.?
2. 42 yards cloth at 19s. 4½d.?
3. 57 yards silk at 10s. 9¾d.?
4. 79 yards cotton at 1s. 7½d.?
5. 89 lbs. tea at 7s. 5¼d. per lb.?
6. 115 lbs. coffee at 2s. 7¾d.?

7. 236 lbs. snuff at 3s. $8\frac{3}{4}$d.?
8. 354 lbs. cloves at 18s. $10\frac{1}{2}$d.?
9. 96 cwt. sugar at £4, 3s. $9\frac{1}{4}$d.?
10. 29 cwt. figs at £1, 9s. $8\frac{3}{4}$d.?
11. 93 stones butter at 19s. $5\frac{1}{2}$d.?
12. 126 stones cheese at 9s., $7\frac{1}{2}$d.?
13. 113 stones wool at 18s. $4\frac{1}{4}$d.?
14. 74 bar. raisins at £4, 14s. 3d.?
15. 130 bales cotton at £2, 7s. 6d.?
16. 43 scores lambs at £12, 16s. 6d.?
17. 52 weeks' wages at £1, 5s. $6\frac{1}{2}$d.?
18. What is the weight of 47 hhds. tobacco, each 6 cwt. 2 qr. 17 lb.?
19. What is the weight of 436 guineas, each 5 dwt. 9 grs.
20. How far will a coach run in 48 hours, at the rate of 8 m. 5 fur. 14 po. 4 y. 2 f. 4 in. per hour?
21. An estate consists of 14 farms, each 117 ac. 2 ro. 13 per. 27 yds.; how much does it measure?
22. How far will a man travel in 58 days, at the rate of 17 m. 5 fur. 27 po. per day?
23. What quantity of wine do 56 casks contain, each 1 hhd. 52 gal. 6 pts? (63 gal.=1 hhd.)
24. What quantity of ale will be consumed in a year at the rate of 3 tuns 5 bar. 3 gal. 5 pts. per day? (36 gal.=1 bar. and 6 bar.=1 tun.)
25. How many bottles of wine will be drawn from 15 pipes, each running 53 doz. 7 bottles?
26. How much flour will a mill grind in 136 days, at 3 qrs. 4 bush. 3 pecks per day?
27. How much flour will the inhabitants of a village consume in a year, at 1 qr. 3 bush. 2 pec. 6 qts. per day?
28. How much corn will grow on 65 acres, at the rate of 9 qr. 3 bush. 2 pec. per acre?
29. How many seeds will be produced from a single plant, which bears 15 stalks, each stalk 12 flowers, and each flower 48 seeds?
30. How many letters are in a book of 12 volumes,

each 421 pages, each page 36 lines, and each line 38 letters?

31. If a man gains 18s. 6d. and spends 14s. 11¾d. per week; what does he lay up in a year?

32. If a man's income is £430 per annum, and his expenses 18s. 5½d. per day; how much does he save in a year?

USES OF DIVISION.

1. When the value, weight, measure, &c. of a given number of articles is given, to find the value &c. of one.

RULE. Divide the value, &c. by the number of articles.

II. When the value, weight, measure, &c. of the whole is given, and also the value, &c. of one, to find the number of articles.

RULE. Divide the value, &c. of the whole by the value, &c, of one, both values, &c. being first reduced to the lowest name mentioned.

III. To find the wages, work, &c. in a single year, day, &c.

RULE. Divide the whole wages, &c. by the number of years, days, &c.

IV. To find the time of earning wages, performing work, &c.

RULE. Divide by the amount of wages, work, &c. per year, day, &c.

1. Divide £452, 16s. 4¾d. among 17 men.

2. Divide 9467 acres, 3 roods, 24 perches, among 26 men.

3. If 11 yards of cloth cost £4, 5s. 0¼d.? what is the price of 1 yard?

4. If 47 lbs. of tea cost £34, 10s. 3¾d.; what is that per lb.?

5. A farm of 57 acres is let for £96, 16s. 6½d.; what is the rent per acre?

6. If $13\frac{3}{4}$ yards of cloth cost £8, 17s. $7\frac{1}{2}$d.; what is that per yard?

7. If $11\frac{5}{6}$ cwt. of sugar cost £46, 16s. 6d.; what is that per cwt.?

8. If 48 yards cost £33, 16s. 6d.; what will 8 yards cost?

9. A cwt. of sugar cost £4, 16s. 8d.; what was that per lb.?

10. Eight men gained jointly £926, 14s. 4d.; what is each man's share of it?

11. Bought 3 cwt. 19 lb. of tobacco for £71; what did it cost me per lb.?

12. If 19 hhds. of sugar weigh 141 cwt. 2 qr. 24 lb.; what is the weight per hhd.?

13. If 7 casks weigh 1 ton, 3 cwt. 3 qrs. 21 lb.; what does a cask weigh?

14. If 28 casks contain 3 hhds. 38 gal. 4 pts. (63 gals, =1 hhd.); what will 7 of them contain?

15. A labourer earns 23s. 4d. per week; how much should he spend in a week to save £11 in a year for his house-rent and clothes?

16. How many hogsheads of sugar, each $11\frac{1}{2}$ cwt., will contain 141,680 lbs.?

17. If 6 chests of tea weigh 8 cwt. 1 qr. 18 lb.; what is the weight of 1 chest?

18. A piece of cloth at 8s. 4d. per yard cost £18, 15s.; how many yards were in it?

19. A piece of gold cost £161, 17s. 6d., at £4, 7s. 6d. per oz.; what what was its weight?

20. How many canisters, each holding 12 lbs., can be filled out of 28 cwt. 2 qr. 24 lb. of tea?

21. A gentleman distributed £5, 13s. 4d. among some poor people, giving each of them 6s. 8d.; how many poor were there?

22. The revenues of an hospital amount to £5629, 10s.; how many patients will it maintain, when each requires £8, 13s. 9d. per annum?

23. In 20,790 gallons, how many puncheons (84 gal-

lons), hogsheads (63 gallons), and tierces (42 gallons), and equal numbers of each?

24. The distance between London and Edinburgh is 390 miles, 3 furlongs, 20 poles; how often will a coach-wheel of 15 feet circumference revolve in performing the journey?

25. Three men cleared upon an adventure £878, 3s.; what was each man's share?

26. Divide £115, 10s. among 5 men and 6 women, and give each man thrice the share of a woman?

27. Divide £550, 3s. 1½d. among 4 men, 6 women, and 8 children, and give a man double of a woman, and a woman triple of a child.

28. Divide £7464, 14s. 8d. among a captain, a lieutenant, and 76 men, and give the captain $\frac{1}{7}$ of the whole, and the lieutenant as much as 6 men?

29. Divide £9648, 16s. among a father, a son, and 2 daughters, and give the father triple of the son, and the son 4 times as much as each of the daughters?

30. Divide £6842, 14s. 6d. among three persons, so that A shall have £568, 14s. 4d. more than B, and B £728, 18s. 2d. more than C.

31. How much tea, at 6s. 6d. per lb., can be purchased for £136, 14s. 8d.?

32. The rent of a farm at 27s. per acre, amounted to £842, 14s. 6d.; how many acres did it contain?

33. The weight of 6 qrs. 2 bus. 2 pec. 2 qts. 1 pt. of wheat was 14 cwt. 3 qrs. 14 lb.; what is the weight of a peck?

PROMISCUOUS EXERCISES.

When a question requires both addition and subtraction, or both multiplication and division, these may be performed in any order, but it is generally more convenient to add before subtracting, and to multiply before dividing?

1. What is the value of 9¾ gallons rum at 19s. 7½d. per gallon?

2. Bought sugar at £4, 8s. 8d. per cwt.; what did it cost me per lb.

3. How many days are between the 17th March and the 25th September?

4. If the year begin on Friday, on what day of the week will the anniversary of the battle of Waterloo happen, being the 18th of June?

5. If the 7th of June fall on Monday, on what day of the week did the year begin?

6. After paying at one time £57, 16s., at another time £250, 16s. 6d., at a third £386, 12s. 8½d., and at a fourth £107, 13s. 7½d., there remained due £127, 19s. 4d.; how much was the original debt?

7. Gained £15, 3s. 4d., but afterwards lost of it £9, 16s. 7½d.; what is my net gain?

8. What is the value of 38 sets china at £3, 18s. 9½d. per set?

9. If 37 yards of cloth cost £43, 14s. 4½d.; what is that per yard?

10. How many pounds sterling are in 48 purses, each containing a joannes 36s. a moidore 27s., a half-guinea, and a half-crown?

11. In 7 ml. 5 fur. 13 poles, 3 yd. 2 ft. 7 in.; how many lines?

12. Two horses with their harness cost £250, the first horse with the harness cost £181, 13s. 7d., and the second horse with the harness cost £155, 6s. 5d.; what did the harness and each of the horses cost separately?

13. How much in length will a man dig in 73 days, at the rate of 2 po. 1 yd. 2 ft. 9 in. per day?

14. In 96842429 inches, how many miles?

15. In 17 ac. 2 ro. 29 per., how many square inches?

16. A ship was bought for £630, repairs £103, 13s. 7d., victualling £52, 7s. 8½d., wages £23, 14s. 8d., insurance £47, 12s.; how much did she cost in all?

17. A labourer's house-rent is £4, 16s. in a year; how much must he lay up weekly to pay it?

18. Seven ladies purchased a chest of tea, which weighed 3 qrs. 21 lb.; how many lbs. did each receive?

19. A gentleman gave £3 to pay for bed and lodging during the month of August, at 1s. 8d. per night; what change will be returned to him?

20. A gentleman bequeathed to the eldest of his three daughters £3000 more than to the second, and to the second £2000 more than to the third, whose portion was £9680; what was the portion of each of the others, and the amount left them?

21. How many guineas, half-guineas, crowns, and half-crowns, and the same number of each, are in £39?

22. In 9684278 square inches, how many perches?

23. In 742831 square links, how many acres, roods, &c.?

24. If the interest of the national debt is £1, 2s. 2d. per second, what is it per solar year?

25. The sun's distance from the earth is 95 millions of miles, and that of the moon from the earth is 240,000 miles; required the moon's distance from the sun at the time of an eclipse of the sun, when she is between the earth and the sun?

26. How many inches will reach round the earth, supposing it to be a perfect sphere, of which the circumference is 360 degrees, and each degree $69\frac{1}{5}$ English miles?

27. What is the stock of a company which consists of 135 shares, each £562, 18s. 6d.?

28. A father has six children, of which the youngest is now 18 yrs. 10 mo. 1 we. 5 da. old, the interval between each of their births was 1 ye. 9 mo. 1 we. 6 d., and the father was 22 y. 7 mo. 3 we. 1 d. old when his first child was born; what is his age now, reckoning 13 months of four weeks to a year?

29. What is the net weight of 36 hhds. sugar, each 8 cwt. 3 qrs. gross, and the tare 18 lbs. 2 oz. 12 drs. per hhd.?

30. A merchant bought 7 pieces of cloth, each 27 yards, for £55, 12s., and sold 56 yards of it at 5s. $3\frac{1}{2}$d. per yard; at what must he sell the remainder per yard to gain £3, 11s. on the whole?

31. A cask of wine was calculated to contain 29 dozen, 8 bottles, and there were bottled at one time 11 dozen 3 bottles, at another 7 dozen 10 bottles, at a third 4 dozen 4 bottles, and at a fourth 5 dozen 6 bottles, which emptied the cask; how much did it inlake?

32. If the population of the earth be 711,623,880, and a generation last 33 Julian years, how many die per hour?

33. The planet Mercury performs 148 revolutions round the sun in 35 common years, 249 days; required the time of one revolution?

34. How many revolutions have each of the planets performed since the commencement of time, supposing it to be 5830 solar years, and that the times of one revolution are, Mercury 87 da. 23 ho. 16 min., Venus 224 da. 16 ho. 49 min., the Earth 365 da. 6 ho. 9 min., Mars 686 da. 23 ho. 31 min., Jupiter 4332 da. 14 ho. 27 min., Saturn 10,759 da. 1 ho. 51 min., and Herschel 30,737 da. 18 ho.?

BILLS OF PARCELS.

1. Mr. John Adams

1830. Bought of James Simson,

March 5,	7 yards of lawn,	at 2s. 8d.
	8 yards of linen,	at 5s. 7d.
	9 yards of cambric,	at 2s. 9d.
	3 yards of calico,	at 3s. 1d.
	12 yards of gauze,	at 8s. 4d.
	28 yards of lace,	at 2s. 9d.

2. Mr. Peter Ward bought of John Smith, May 8, 1830, 34 reams thick post, at 33s. per ream; 27 reams thin do., at 23s.; 16 reams foolscap, at 19s.; 130 reams demy, at 15s. 6d.; 8 reams royal, at 43s.; 27 reams cartridge, at 14s. 6d.; 7 cwt. pasteboard, at 17s. 6d.

3. Mr. William Grant bought of John Niven, 36 yards superfine cloth, at 22s. per yard; 5 pieces satin, each

20 yards, at 14s. 6d.; 7 pieces do., each 30 yards, at 12s. 3d.; 5 pieces lustring, each 18 yards, at 7s. 6d.; 28 yards silk, at 14s.; 3 pieces damask, each 30 yards, at 10s. 6d.; 53 yards silk, at 7s. 4d.

4. Mr. Robert Watt bought of Thomas Tait, 550 yards plain linen, at 2s. 8¾d. per yard; 654 yards striped do., at 2s. 8½d.; 780 yards flowered do., at 13s. 4½d.; 660 yards sprigged do., at 7s. 8¾d; 950 yards cambric, at 7s. 8½d. 460 yards striped do., at 13s. 4¼d.; 468 yards flowered do., at 7s. 8½d.; 860 yards silk gauzes, at 3s. 11½d.

5. Mr. John Wilson bought of Robert Jones, 5¾ yards superfine black cloth, at 27s. 6d.; 8½ yards do. blue at 24s. 8½d.; 12⅓ yards do. olive, at 18s. 6¾d.; 18¼ yards do. brown, at 17s. 8d.; 26⅛ yards do. drab, at 14s. 6d.; and 38½ yards do. mixt, at 12s. 9½d.; what does the whole amount to?

6. Mr. Peter Pipes bought of Watkin Willis, 42 doz. port wine, at 33s. 6d.; 59 doz. sherry, at 35s. 9d.; 47 doz. claret, at 65s. 11¾d.; 23 doz. burgundy, at 69s. 10½d.; 17 doz. champaign, at £6 11s. 8¼d.; 31 gallons rum, at 18s. 6½d.; 46 gallons brandy, at 33s. 11¾d.; 39 gallons hollands, at 27s. 8¼d.; 58 gallons malt aqua, at 12s. 11½d.; 139 doz. ale, at 6s. 6d.; and 117 doz. London porter, at 5s. 2½d.; what does the whole amount to?

7. Mr. George Dick bought of Abraham Levi, 67½ yards Brussels carpet, at 4s. 10½d. per yard; 89¼ yards do., at 4s. 2d.; 59⅓ yards stair-carpet, at 2s. 9¾d.; 115 yards superfine Scotch carpet, at 3s. 2¼d.; 129 yards fine do., at 2s. 6¾d.; 4 hearth rugs, at 35s. 11½d.; 24 chairs, at 18s. 11½d.; 25 pair blankets, at 15s. 6½d. per pair; 68¾ yards sheeting, at 2s. 7½d. per yard; 4 feather beds, at £4, 17s. 6½d. each; 4 hair-mattresses, at £3, 17s. 6d.; 4 mahogany bedsteads, at £4, 18s. 9½d.; a set of dining-tables, at 11 guineas; 2 couches, at 4 guineas; 2 sofas, at 12 guineas; and 3 chests of drawers, at 7 guineas, besides sundry articles which cost £89, 17s. 6¾d.; he has paid £200, 18s. 6d.; how much is he still owing?

PROPORTION.

Four numbers are proportionals, when the first contains the second as often as the third contains the fourth; or when the first, multiplied by any number, contains the second, as often as the third, multiplied by the same number, contains the fourth.

Thus 24, 8, 6, 2, are proportionals, because 24 contains 8 three times, and 6 contains 2 three times. Also 63, 18, 14, 4, are proportionals, because 63×2 contains 18 seven times, and 14×2 contains 4 seven times.

In Simple Proportion three numbers are given to find a fourth, and of the three given, two are always of a like kind, and the other is of the same kind as that required.

RULE FOR STATING. Place the three given numbers in one line. First write the term which is like the number sought.

If the number sought is to be greater than that written down, place the greater of the other two towards the right hand of the other, but if it is to be less, place the less towards the right.

Two points are to be placed between the left-hand term and the middle one, and four points between the middle and the right-hand term.

Thus, if 7 yards cost £5, what will 28 yards cost? The number sought is money, therefore £5 is first written; and 28 yds. will cost more than 7 yds., therefore 28 is written to the right of 7.

yds.	yds.	£
7	: 28 : :	5

If 7 men do a piece of work in 28 days, in what time will 14 men do it?

Here days are sought, write 28 days first; and 14 men will take fewer days, therefore the less 7 is placed towards the right of 14.

m.	m.	da.
14	: 7 :	28

RULE FOR WORKING. Reduce the two like terms to the same name, and the other to the lowest name in it.

Multiply the two right-hand terms together, and divide the product by the left-hand term. The quotient is the answer, and it is always of the same name with that to which the first term was reduced.

NOTE 1. When the like terms are not great, instead of reducing the other term, work as in compound multiplication and division.

NOTE 2. When there is a remainder after dividing by the left-hand term, the lower names of the answer are to be found as in compound division, Rule I.

CONTRACTION. If the left-hand term and either of the other two are divisible by the same number, divide them by it, and use the quotients instead of them.

1. If 12 yards of cloth cost £16, how many may be bought for £72?

	£	£	yds.	£	£	yds.
By contracting,	8)16	: 72	:: 12	16	: 72	:: 12
divide the left					12	
and middle by	2) 2	: 9	:: 12			
8, and then the					16)864	
left, and right	1	: 9	:: 6			
by 2.		6		Ans. 54 yards.		

Ans. 54 yards.

2. If 24 horses are maintained in hay for a certain sum, when hay is at 10d. per stone, how many will be maintained for the same money, when hay is at a shilling per stone?

12)12d. : 10d. : : 24 horses.

1 : 10 :: 2
2

Ans. 20 horses.

3. If 6 yards of cloth cost £4, 10s., what will 30 yards cost?

4. If 30 yards cost £22, 10s., what will 6 yards cost?

PROOF. By altering the 3d, as is done in the 4th, we obtain the proof of the 3d; but it may always be done by

multiplying the answer by the left-hand term, and dividing by the middle term; the quotient should be the right-hand term as in the next.

5. If I pay £4, 10s. for 6 yards of cloth, how many yards can I buy for £22, 10s.?

6. If 30 yards of cloth cost £22, 10s. how many will I get for £4, 10s.?

7. If 57 cwt. of sugar cost £216, what will 95 cwt. cost?

8. If 385 yards linen cost £63, how much may be bought for £18?

9. If 90 gallons of wine cost £72, how much may be bought for £396?

10. If the rent of 42 acres is £63, what is the rent of a farm of 182 acres?

11. If 275 reams of paper cost £330, what would 990 reams of it cost?

12. If 148 gallons of rum cost £119, 10s., how much of it may be bought for £89, 12s. 6d.?

13. If 52 cwt. 1 qr. 4 lb. of flour cost £114, what would 122 cwt. cost?

14. If 36 ac. 3 ro. of land are rented for £42, what should be the rent of 21 ac. 3 ro. 20 per.?

15. If I pay £51 for 10 cwt. 2 qr. 14 lb. of sugar, what would 4 cwt. 1 qr. 14 lb. cost?

16. If 19 cwt. 3 qr. 21 lb. of beef cost £36, what would 46 cwt. 1 qr. 20 lb. cost?

17. If I pay [illegible] 4d. of coach-hire for 88 miles, for what distance would I pay £2, 3s. 4d.?

18. If 5 acres are rented for £4, 13s. 4d., how much may be rented for £70, 10s. 6d.?

19. How much wheat, at 18s. 3d. per cwt., may be bought for £64, 3s. 2½d.?

20. If 6 cwt. 3 qr. 12 lb. of flour cost £9, what would 4 cwt. 2 qrs. cost?

21. If 39 cwt. 1 qr. 11 lb. of pork cost £59, 1s. 3d., what would 13 cwt. of it cost?

22. If 63 galls. of wine cost £41, 10s. 6¼d., what would 10 galls. cost?

23. If 36 tons of logwood cost £316, 7s. 3d., what would 4 tons cost?

24. If 4¼ yards of cloth cost £5, 14s. 4½d, what would 20 yards cost?

25. If 1¼ yard of cotton cost 2s. 6d., what cost 24½ yds.?

26. If 1½ cwt. of sugar cost 7 guineas, what will 7 lbs. cost?

27. If 1¼ oz. of tea cost 6¼d. what will 24 lbs. cost?

28. If 2½ cwt. of coffee cost £42, what will 12 oz. cost?

29. If 3 quarters of a yard cost a guinea, what will 3 pieces, each 25½ yards, cost?

30. If 1½ oz. of snuff cost 6d, what would 3 cwt. 3 qr. 18 lb. cost?

31. If 51 lbs. of tea cost £8, 10s., what will 7 canisters, each 2¾ cwt., cost?

32. How much tea may be bought for £7, 8s. 5¼d., when 14 cwt. 3 qr. cost £436, 8s. 1½d.?

33. What is a man's wages for 146 days, at the rate of £37, 4s. 1d. per annum?

34. What is the price of 6 cheeses, each 14¾ lbs., at 3s. 4½d. for 7 lbs.?

35. If 6½ yds. muslin cost £1, 6s. 6½d., what will 3 pieces, each 22½ yards, cost?

36. If a ton of iron cost £23, 6s. 8d., how much might be bought for 6¼d.?

37. If 17 acres produce 51 [illegible] 2 pe., what will 27 ac. 2 ro. 20 per. produce?

38. If 9 acres produce 29 qrs. 2 bu. how much land will produce 100 qrs.?

39. If 4 casks of raisins, each 1 cwt. 2 qr. 16 lb., cost £23, what quantity can be bought for £3, 10s.?

40. If 1¾ ounces of silver cost 9s 7½d., what will 24½ lbs. cost?

41. If 14 packs of wool, each 420 lbs., cost £109, 4s., what is that the cwt.?

42. If 8 cwt. 3 qrs. are carried 110 miles for 30s., how far should 3 cwt. 3 qrs. be carried for that money?

43. If a carding machine throw off 21 lb. of wool in 1 hour, $4\frac{2}{4}$ minutes, in what time will it throw off 54 lbs.?

44. If $46\frac{2}{3}$ shilling loaves can be got from a qr. of wheat, how many 8d. loaves can be got from it?

45. Borrowed 252 qrs. of wheat, when the price was at £4, 11s., what quantity should I return when the price is at 4 guineas?

46. If 20 acres of land worth 20 guineas per acre, are exchanged for 35 acres of other land, what should be the value of an acre of this land?

47. If the teeth of 40 combs can be cut in an hour, how many can be manufactured in 6 days, by working 8 hours per day?

48. If 42 men perform a piece of work in 108 days, in what time will 72 men do it?

49. If 28 persons reap a harvest in 36 days, how many must be employed to do it in 9 days?

50. If 57 masons finish a house in 156 days, in what time should 36 masons do as much work?

51. If 70 men consume 108 casks of provisions in 12 months, how long would these provisions last 210 men?

52. If 2000 men have provisions for 6 months, how many men would the same quantity serve 8 months?

53. If 770 pigs of lead, each 2 cwt. 1 qr. 8 lb. cost £2268, 15s, what is that per fodder of $19\frac{1}{2}$ cwt.?

54. What is the value of 7 pieces of gold, each 3 lb. 8 oz., at £3, 19s. 6d. per ounce?

55. What is silver at per ounce, when 4 lb. 10 oz. cost £24, 17s. 10d.?

56. How much land at 27s. per acre, should be given in exchange for 480 acres at 45s. 6d. per acre?

57. How much water must be mixed with rum, at 18s. per gallon, to fill a cask of 100 gallons, so that a gallon may be worth 15s.?

58. Bought 24 pockets of hops, each 1 cwt. 2 qr. 17 lb., for £201, 3s. 9d.; what did they cost me per cwt.?

59. If the 9d. loaf weighs 48 oz. when wheat is at 56s. per quarter, what should the shilling loaf weigh then?

60. If the 6d. loaf weighs 3 lb. when wheat is at 3 guineas, what should the wheat cost when the 6d. loaf weighs 2 lb. 8 oz. 8 dwt.?

61. If the 8d. loaf weighs 50 oz. when wheat is at £3, 8s., what should it weigh when wheat is at £2, 11s.?

62. If 2 leaps of a dog are equal to 3 leaps of a hare, how many of the hare's leaps are equal to 120 leaps of the dog?

63. How much muslin at 2s. 8½d. per yd., should be given for 169 yds. of cambric, at 7s. 8½d. per yd.?

64. If the assessment on 445 acres is £14, 14s. 9¾d., what is it per score of acres?

65. If a man's wages in a year are £89, 12s. 6d., how much should he receive from the 1st of May to the 18th of December?

66. When wheat is at 57s. 4½d. per quarter, how much is it per cwt., at 57¾ lbs. avoirdupois in a standard bushel?

67. If 11 sheep produce 28 lb. of wool, how much will 12 millions of sheep produce?

68. The roof of a house required 5505 lb. of lead to cover it; what did it cost at 39s. per cwt.?

69. A person travelling 14 hours per day, finished his journey in 9 days; how many days will he take in returning, when he travels only 10 hours a-day?

70. The length of a wall measured by the chain was 2456 links, but it was found that the chain was 67½ feet long, instead of 66; how many [illegible] the wall measure?

71. Bought 36 lbs. of beef, each 17½ ounces; what is the weight in avoirdupois pounds?

72. A retailer of spirits made use of a Scotch pint containing 103⅖ cubic inches, instead of a half-gallon of 115½ cubic inches; how much did he defraud the public by selling 100 such gallons?

73. How many pairs of gloves, at 15d. per pair, ought to be exchanged for 42 dozen, 4 pairs of stockings, at £2, 16s. 6d. per dozen?

74. If a garrison has provisions for 10 months, at the rate of 16 ounces to each person per day, how much must be allowed to each per day, that these provisions may last a year?

75. If a garrison's provisions will last 8 months, at the rate of 18 oz. to each person per day, how long will they last if 15 oz. be allowed to each?

76. A bankrupt's debts amount to £9356; how much will he pay at 11s. 6d. per pound?

77. A bankrupt's effects amounted to £980, which afforded his creditors 13s. 6d. per pound; what did his debts amount to?

78. A bankrupt, who owed £1920, paid his creditors £1008; how much was that per pound?

79. What is the interest of £1750 for a year, at 5 per cent., or £5 interest for £100?

80. What is the commission on £256, 18s. at 2½ per cent.?

81. If £425 gain £20, 3s. 9d., what is the rate per cent. or for £100?

82. What principal will gain £64, 5s. 6d. in a year, at 5 per cent.?

83. If a certain principal will gain £48, 16s. in a year, what will it gain in 15 months?

84. If £125 gain a certain sum in 8 months, what principal will gain as much in 6 months?

85. If £150 gain £7 in 10 months, in what time will £225 gain as much?

86. How much cloth at 22s. 6d. per yd., ought to be given for 8 pieces, each 18 yds. at 15s. per yd.?

87. Exchanged 64 yards cambric, at 8s. per yard, for 192 yards cotton cloth; what did the cotton stand me per yard?

88. How much cloth, 3 quarters wide, ought to be given for 90 yards of the same quality, which is 5 quarters wide?

89. If the tax on a rent of £25 is £2, 10s., what will it be on a rent of £450?

90. What is the tax on a house rented at £65, 10s. 6d., at 3s. 6d. per pound?

91. How much paper, 26 inches wide, will be required to line a room, when one of the same dimensions took 37 yards, 4 quarters wide?

COMPOUND PROPORTION.

When the result depends upon more than one circumstance or number, the proportion is said to be compound.

Here one of the given numbers is of the same kind with that required, and the others taken two and two are like one another.

RULE FOR STATING. Write the term which is like the number sought; and first take two numbers, of the same kind, and state them as in simple proportion, as if there were no other numbers in the question; then take other two like one another, and state them in the same manner under the former, and so on till all the numbers are stated.

RULE FOR WORKING. Reduce like terms to the same name, and that like the answer to the lowest name in it.

Multiply the terms under one another successively, which will reduce them to three; then multiply the two right-hand terms, and divide by the left-hand term, as in simple proportion.

PROOF. Take the three terms first stated, and work with them as in simple proportion; then take the result and the two like terms next stated, and work with them in the same manner, and so on; the last result will be the number sought.

CONTRACTION.—When a left-hand term and any other are divisible by the same number, divide them by it. Do this as often as possible, and use the quotients instead of the numbers. This is best done by placing the left-hand

terms under a line, and all the rest above it, and dividing one above and one below it.

1. If 15 pecks of wheat serve a family of 9 persons for 22 days, how long will 20 pecks serve a family of 6 persons?

Days being sought, 22 is first written. Now, 20 pecks will serve longer than 15, therefore 20 is put to the right; and they will serve 6 persons longer than 9, so that 9 is put to the right.

pecks 15 : 20 : : 22 days.
persons 6 : 9

90 180
22

90)3960

Ans. 44 days.

2. If £36 value of corn maintain 18 men 9 months, when corn is at 64s. per qr., how many men should be maintained 6 mo. for £54, when the rate of corn is 48s.?

£36 : 54 : : 18 men.
months 6 : 9
shillings 48 : 64

288 576
36 54

10368 31104
18

10368)559872(54 men, Ans.

3. If 6 men earn 15 guineas of wages in 15 days, how much will 10 men earn in 27 days?

4. If 7 men gain 4 guineas in 3 days, in what time will 14 men gain £56?

5. If 12 persons spend £160 in 4 months, how many will £853, 6s. 8d. serve for 8 months?

6. If 1050 soldiers consume 250 quarters of corn in 6 months, how many will 960 quarters serve 4 months?

7. If 2 casks of beer serve 8 persons 14 days, how many casks will serve 4 persons for a year?

8. If 10 men in six weeks earn £90, in what time will 15 men earn £160?

9. If 12 sailors consume 48 lbs. of beef in a week, how many will 19,800 lbs. serve for 9 weeks?

10. If 8 horses eat 12 qrs. of oats in 36 days, how many qrs. will 12 horses eat in 48 days?

11. If 3 horses eat 14 pecks of oats in 7 days, how many horses will 263 quarters serve a year?

12. If 12 masons build 7 roods in 36 days, how much will 48 masons build in 24 days?

13. If 15 masons build 37 roods in 27 days, in what time will 20 masons build 148 roods?

14. If 21 men cut down 72 acres of grass in 60 days, how many men must be employed to cut down 460 acres, 3 roods, 8 poles, in 72 days?

15. If 12 ounces of wool are sufficient for $2\frac{1}{2}$ yards of cloth 6 quarters wide, how much wool will be required to make 150 yards, 4 quarters wide?

16. If 10 ounces of wool make 5 yards of cloth, 3 quarters wide, how much cloth, 5 quarters wide, should be made from 250 stones, each 14 lb.?

17. If 3000 copies of a book, of 11 sheets, require 66 reams of paper, how much paper will be required for 5000 copies of a book, of $12\frac{1}{2}$ sheets?

18. If 6 compositors set up a work of 6 sheets in 10 days, in what time will 4 compositors set up a work of 12 sheets?

19. If £100 gain £5 in a year, what will £650 gain in 219 days?

20. If £600 gain £45 in 18 months, how much will £100 gain in a year?

21. If £100 gain £4 in a year, what will £375 gain in 39 weeks?

22. If £175 gain £5, 18s. $1\frac{1}{2}$d. in 39 weeks, what will £100 gain in a year?

23. If £100 gain £3, 15s. in a year, how much must be laid out to gain £88, 2s. 6d. in 5 years?

24. If £100 gain £$4\frac{1}{2}$ in a year, in what time will £975 gain £191, 2s.?

25. If the 9d. loaf weighs 54 ounces when wheat is at 8s. per bushel, what should the shilling loaf weigh when wheat is at 7s. 6d. per bushel?

26. If the 8d. loaf weighs 48 oz. when wheat is at 54s. per quarter, what should be the price of wheat when the 6d. loaf weighs 32 oz. 8 dwt.?

27. If the 3d. loaf weighs 28 oz. when wheat is at 10s., what should be paid for a loaf weighing 4 lb. 6 oz. when wheat is at 8s.

28. If 45 tenpence loaves can be made from 6 bushels of wheat, how many 8d. loaves can be got from 9 qrs.?

29. If 118 men eat 80 qrs. of wheat in 108 days, how many qrs. will 88 men eat in a year and 107 days?

30. If 59 men eat 20 qrs. of wheat in 55 days, how long will 180 qrs. serve 77 men?

31. If a man travels 90 miles in 3 days by walking 8 hours a-day, in what time will he travel 540 miles by walking 6 hours a-day?

32. If 3 persons are boarded 4 weeks for £7, how long ought 14 persons to be boarded for £112?

33. If 30 cwt. are carried 15 miles for £5, 8s. 9d., how far ought 80 cwt. to be carried for £29?

34. If 60 packs of wool are carried 12 miles for £15, 6s. 8d., when the rate of carriage is 8d. per stone per mile, how many such packs ought to be carried 54 miles for £190, when the carriage is at 6d.?

35. If 12 casks are carried 18 miles for £16, when the carriage is at 15d., how far should 18 casks be carried for £72, when the carriage is at 10d.?

36. If 18 men eat 16s. worth of bread in 3 days, when wheat is at 54s., what value of bread will 45 men eat in 27 days, when wheat is at 45s.?

37. If 18 men cast 30 yards of ditching in 24 days by working 8 hours per day, how many will cast 60 yards in 64 days, working 6 hours a-day?

38. If 12 men build 24 roods in 30 days, working 8 hours per day, how many hours per day must 18 men work to build 72 roods in 40 days?

39. If 36 men cast a ditch 64 ft. long, 16 ft. broad, and

8 ft. deep, in 48 days by working 9 hours a-day, what length of a ditch, 18 ft. broad, and 9 ft. deep, will 6 men cast in 72 days, by working 6 hours a-day?

40. If 12 men build a wall 60 ft. long, 4 thick, and 20 in height, in 24 days, working 12 hours a-day, how many must be employed to build a wall 100 ft. long, 3 thick, and 12 high, in 18 days, working 8 hours per day?

41. If 248 men in 11 days of 11 hours dig a trench of 7 degrees of hardness, 465 ft. long, 55 ft. wide, and 14 ft. deep. In what time will 24 men dig a trench of 4 degrees of hardness, which is 675 ft. long, 84 ft. wide, and 21 ft. deep, by working 9 hours a day?

PRACTICE.

Practice is the method of calculating prices, &c. by means of aliquot parts.

NOTE.—An aliquot part of any number is such a part of it as being taken a certain number of times, will exactly produce the number; thus, 5 is an aliquot part of 20, because 5 times 4 are 20.

TABLE OF ALIQUOT PARTS.

Of a Shilling.	Of a Pound.	Of a Guinea.	Of a Cwt.
6d. = $\frac{1}{2}$s.	10s. 0d. = $\frac{1}{2}$£	10s. 6d. = $\frac{1}{2}$g.	56 lb. = $\frac{1}{2}$c.
4 = $\frac{1}{3}$	6 8 = $\frac{1}{3}$	7 0 = $\frac{1}{3}$	28 = $\frac{1}{4}$
3 = $\frac{1}{4}$	5 0 = $\frac{1}{4}$	5 3 = $\frac{1}{4}$	16 = $\frac{1}{7}$
2 = $\frac{1}{6}$	4 0 = $\frac{1}{6}$	3 6 = $\frac{1}{6}$	14 = $\frac{1}{8}$
1½ = $\frac{1}{8}$	3 4 = $\frac{1}{6}$	3 0 = $\frac{1}{7}$	8 = $\frac{1}{14}$
1 = $\frac{1}{12}$	2 6 = $\frac{1}{8}$	2 4 = $\frac{1}{8}$	7 = $\frac{1}{16}$
Of a Sixpence.	2 0 = $\frac{1}{10}$	1 9 = $\frac{1}{12}$	Of a Quarter.
¾d. = $\frac{1}{8}$	1 8 = $\frac{1}{12}$	1 6 = $\frac{1}{14}$	14 lb. = $\frac{1}{2}$
½ = $\frac{1}{12}$	1 4 = $\frac{1}{15}$	1 2 = $\frac{1}{18}$	7 = $\frac{1}{4}$
¼ = $\frac{1}{24}$	1 3 = $\frac{1}{16}$	0 9 = $\frac{1}{28}$	4 = $\frac{1}{7}$
			3½ = $\frac{1}{8}$
			2 = $\frac{1}{14}$

To find whether a number of a lower name be an aliquot part of a higher; divide the number of the lower which make one of the higher by the given number. If there is a remainder, it is not a part; but if there is no remainder, the quotient shows what part it is. Thus, 20 is not divisible by 7, therefore 7s. is not a part of £1; but 20, divided by 5, gives 4 for a quotient, without a remainder, therefore 5s. is one-fourth of £1.

It is obvious, that any number of articles, at £1 each, will cost as many pounds as there are articles; and the same is true of any number at 1 shilling or 1 guinea. This is the fundamental principle of the method of practice.

CASE I. When the price is an aliquot part of a higher name.

RULE. Take a like part of the number of articles supposed to be so many of that higher name, and the result will be the value in that name.

NOTE 1. The remainder is so many times the given price.

NOTE 2. When the part of a guinea is taken, the answer may be expressed in pounds by calling the guineas pounds, and adding as many shillings to them.

1. What cost 794 y. lb. &c. at 5s.?

5s. = ¼ £) £794

Ans. £198, 10s.

2. Value of 575 lb. at 4d.?

4d. = ⅓s. | 575.

20 | 191s. 8d.

Ans. £9, 11s. 8d.

3.	Value of 853 yards at	4s. 0d.
4.	975	2s. 0d.
5.	856	6s. 8d.
6.	653	3s. 4d.
7.	999	2s. 6d.
8.	577	1s. 8d.
9.	399	1s. 4d.
10.	767	1s. 3d.
11.	848	0s. 6d.

12.	Value of 678 yards at	0s. 3d.
13.	974	0s. 1½d.
14.	593	0s. 0¾d.
15.	678	0s. 0¾d.
16.	749	0s. 0¼d.
17.	759	3s. 0d.
18.	958	2s. 4d.
19.	358	1s. 9d.
20.	1247	1s. 2d.
21.	874	5s. 0d.
22.	1382	10s. 6d.
23.	999	7s. 0d.
24.	4218	0s. 2d.
25.	679	3s. 6d.
26.	842	10s. 0d.
27.	968	5s. 3d.
28.	1245	0s. 4d.
29.	678	1s. 6d.
30.	6739	0s. 0¾d.

CASE II. When the price is not an exact part of a higher name.

RULE. Take an exact part less than the price, and, if the remainder is not a part, take a part less than it, and so on; then find the values at all these prices, and add them. The sum is the value at the given price.

NOTE 1. After one part is taken, a part of it may be taken.

NOTE 2. We may take a part greater than the price and the difference, and subtract the values at them.

NOTE 3. When there are pounds in the price, multiply by them; and sometimes, when there are no pounds given, it will be easiest to multiply by the shillings, and to take parts for the pence, &c., particularly between 1s. and 2s.

1. Value of 367 yds. at 15s.

10s.=½£)£367 at £1

5s.=½ 10s.)183 10 at 10s.
91 15 at 5s.

Ans. £275, 5 at 15s.

2. Val. of 568 oz. at 9d. each

6d.=½s.)568s. at 1s.

3d.=½ 6d.)284 at 6d.
142 at 3d.

20)426s.

Ans. £21, 6s. at 9d.

3.	Value of 853 lbs. at	0s.		2½d.
4.	567	0s.		3¼d.
5.	845	0s.		3½d.
6.	789	0s.		3¾d.
7.	957	0s.		4¼d.
8.	751	0s.		5½d.
9.	873	0s.		6½d.
10.	897	0s.		7½d.
11.	764	0s.		9d.
12.	856	0s.		10½d.
13.	684	0s.		11d.
14.	819	1s.		1d.
15.	567	1s.		2½d.
16.	876	1s.		10d.
17.	847	2s.		2d.
18.	579	3s.		9d.
19.	678	4s.		8d.
20.	796	6s.		3d.
21.	856	7s.		6d.
22.	579	5s.		10d.
23.	983	3s.		10½d.
24.	674	£4,	8s.	4d.
25.	571	1	11	8
26.	638	2	17	4
27.	674	7	7	7
28.	975	18	19	0
29.	486	23	13	0
30.	516	8	8	8
31.	478	0	11	8

32.	Value of 576 lbs. at	£0,	12s.	6d.
33.	947	0	13	4
34.	847	0	16	8
35.	953	2	9	6
36.	735	1	11	8
37.	586	2	17	4
38.	572	19	18	0
39.	678	9	9	9
40.	257	14	15	6

REMARK. These two rules comprehend all that has been generally delivered on practice when the quantity is a whole number; but the following is the most general and easy method when the price is not an exact part.

GENERAL RULE. To the half of the shillings prefix the pounds, if any, and by this multiply the quantity; if there are pence, take parts of 2 shillings for them, and if there is a remainder, take the part out of its double, considered as shillings. Afterwards add and double the right-hand figure of the integer product, and add it to the shillings; the rest are pounds.

1. Value of 638 yds. at £1, 18s. 8d.

	19		
	12122	s.	d.
8d.=$\frac{1}{3}$	212	1	4
Ans.	£1233	9	4

2. Val. of 857 oz. at 11d.

8d.=$\frac{1}{3}$	857	s.	d.
3d.=$\frac{1}{3}$	285	1	4
	107	0	3
Ans.	£39	5	7

3.	Value of 678 yds. at	£0,	14s.	0d.
4.	567	0	8	0
5.	468	0	17	0
6.	579	0	19	0
7.	634	1	13	0
8.	571	1	17	0
9.	658	2	16	0
10.	795	3	9	0
11.	574	5	3	0
12.	699	1	17	6
13.	589	2	9	4

14.	Value of 637 yds. at	£5	18	7
15.	752	7	9	5
16.	678	3	5	10
17.	731	1	19	9
18.	567	0	14	9
19.	786	0	17	3
20.	633	0	9	10
21.	986	0	0	$10\frac{1}{2}$
22.	837	0	0	$5\frac{1}{4}$
23.	759	0	0	$11\frac{1}{2}$
24.	967	0	1	$1\frac{1}{4}$
25.	263	0	1	$2\frac{1}{2}$
26.	345	0	1	$6\frac{3}{4}$
27.	252	0	3	$9\frac{1}{2}$
28.	546	0	9	$9\frac{3}{4}$
29.	698	0	13	10
30.	285	3	17	8
31.	103	5	14	10
32.	598	2	12	6
33.	219	11	7	8
34.	395	4	12	10
35.	548	5	17	7
36.	475	14	13	9

CASE III. When the quantity contains a fraction.

RULE. Having found the value of the integers by one of the preceding rules, for the fraction take the same part of the price which the upper figure is of the under. If the figure upper is not a part of the under, divide it into such parts.

1.	Value of $73\frac{1}{2}$ yds. at	£1,	8s.	4d.
2.	$53\frac{1}{3}$	0	9	8
3.	$557\frac{1}{4}$	0	17	6
4.	$897\frac{1}{8}$	3	5	5
5.	$678\frac{1}{6}$	4	8	6
6.	$197\frac{3}{4}$	6	8	2
7.	$537\frac{3}{8}$	0	19	9
8.	$477\frac{5}{6}$	1	2	10
9.	$734\frac{7}{12}$	3	3	3

10. Value of $673\frac{7}{10}$ yds. at £3 18s. 8d.
11. $389\frac{8}{15}$ 5 11 6
12. $745\frac{2}{3}$ 4 9 10

CASE IV. When the quantity consists of several names.

RULE 1. If the price of the highest name is given, find the value of the quantity of that name as before, and take parts of the given price for the lower names.

2. If the price of a lower name is given, reduce the quantity to that name, and proceed as before.

What is the value of

1. 568 yds. 3 qrs. at 16s. 8d. per yd.?
2. 957 yds. 2 qrs. 3 na. at 34s. 4d.?
3. 136 cwt. 3 qr. 14 lb. at £4, 16s. per cwt.?
4. 18 cwt. 2 qr. 16 lb. at £3, 18s. 6d.?
5. 21 cwt. 1 qr. 24 lb. at £4, 17s. 8d.?
6. 9 cwt. 2. qr. 22 lb. at £2, 13s. 6d.?
7. 168 cwt. 3 qr. 25 lb. at £4, 8s. 6d.?
8. 0 cwt. 2 qr. 27 lb. at £5, 15s. 9d.?
9. 11 cwt. 0 qr. 13 lb. at £6, 18s.?
10. 748 cwt. 1 qr. 11 lb. at £7, 16s. 8d.?
11. 35 cwt. 3 qr. 14 lb. at 13s. 4d. per qr.
12. 9 cwt. 2 qr. $23\frac{1}{2}$ lb. at 3s. 5d. per lb.?
13. 93 lb. 6 oz. 15 dr. at £1, 11s. 7d.?
14. 9 lbs. 1 oz. 4 dwt. 18 gr. at £3, 12s. 6d.?
15. 39 lb. 10 oz. 13 dwt. 12 gr. at £5, 16s.?
16. 46 acres 3 roods 38 per. at £2, 12s. per acre?
17. 9 qrs. 3 bush. 3 pecks, 1 gal. at £4, 3s. 8d. per qr.
18. 67 doz. 7 bot. at £2, 17s. 6d. per doz.?
19. 25 tons, 11 cwt. 2 qr. 12 lb. at £4, 8s. 4d. per cwt.?
20. 17 cwt. 1 qr. 19 lb. at £78, 16s. per ton?

NOTE 1. If the value of the lower names can be easily found at the rate of £1 for one of the highest, they may be annexed to the highest, and then the work will be as in the two first cases.

NOTE 2. When the price of a lb. is given, the price of

a cwt. may be found by multiplying 9s. 4d. by the pence, and 2s. 4d. by the farthings in the price.

BILLS OF PARCELS.

Edinburgh, 3d October, 1826.

1. Mr. William Jones,

Bought of John Frank,

732 yards linen, at 4s. 1½d. per yard.
87¾ yards cambric, at 12s. 8d.
428½ yards muslin, at 3s. 9½d.

Ans. £287 15 8¾

2. John Wells, Esq. to David White, May 6, 1826, for 7½ yards superfine cloth, at 28s. 6d.; 5 pieces satin, each 18½ yards at 13s. 4d. July 14, 8⅝ yards silk, at 7s. 10d. Sept. 30, 9¾ yards lustring, at 8s. 8d.

3. Leith, 13th June, 1826. Mr. James Fox Dr. to Isaac Grant, To 17 cwt. 2 qrs. 24lb. sugar, at £4, 17s. 6d. per cwt. July 10, To 27 cwt. 1 qr. 19 lb. double-refined sugar, at 5 guin. per cwt. Aug. 6, To 19 cwt. 3 qrs. 16 lb. rice, at £1, 10s. 4d. per cwt. Sept. 18, To 8 cwt. 3 qrs. 7 lb. currants, at £2, 17s. 6d. per cwt.

4. Glasgow, 1826. John King, Esq. to Robert Russel. March 10, To 19 cwt. 1 qr. 27 lb. tobacco, at £15, 10s. 6d. per cwt. May 24, To 4 cwt. 2 qrs. 25 lb. pimento, at £7, 13s. 5d. per cwt. July 19, To 21 cwt. 1 qr. 2 lb. sugar, at £3, 17s. 8d. per cwt. Sept. 6, To 3 cwt. 6 lb. nutmegs, at £16, 8s. 9d. per cwt.

5. June 10, 1830. Mr. John Thomson bought of William Oliver 27½ lbs. green tea at 17s. 6d. per lb.; 17¾ lbs. pekoe do. at 23s. 4d.; 44¾ lbs. hyson at 12s. 9d.; 18½ lbs. bloom at 7s. 8d.; 37 lbs. sugar at 1s. 1½d.; 11 sugar-loaves, each 15¼ lb. at 9¾d. pe rlb.

ALLOWANCES ON GOODS.

In buying and selling goods deductions are made upon the quantity on various accounts. Thus, when the package is of considerable weight, a deduction is made for it, which is called *tare*. Sometimes a deduction is made for shrinkage, called *tret*. It is commonly 4 lb. on 104 lb. And a deduction is given on account of loss in subdividing the quaintity into small portions, which is called cloff, etc.

The weight of the quaintity before the deductions are made is called *gross weight*, and after all the deductions are made it is called *net weight*. After tare is deducted it is called *tare suttle*, and after tret is deducted it is called *tret suttle*, &c. The tare is taken out of the gross weight, the tret out of the tare suttle, and so on.

RULE I. When the tare is at so much per chest, cask, &c. multiply the rate by the number of chests, &c.

II. When it is at so much per cwt., take the same parts of the quantity that the rate is of 1 cwt.

III. When it is at so much on 100, or any other number, multiply by the rate and divide by 100, or by that other number.

IV. To find the tret, take $\frac{1}{25}$ of the tare suttle.

V. To find the cloff from the tret suttle, substract $\frac{1}{25}$ of it, and call the cwts. of the remainder lbs.

1. What is the tare of 72 hhds. sugar, at 26 lb. per hhd.?

2. What is the tare of 56 cwt. 3 qrs. 24 lb. at 4lb. per cwt.

3. What is the net weight of 84 hhds. sugar, each 6 cwt. 2 qrs. 14 lb. at 34 lb. per hhd?

4. Required the net weight of 37 bags of coffee, each 4 cwt. 1 qr. 18 lb. after deducting draft at 1 lb. per bag, and tare at 9 lb. per cwt.?

5. Required the tret on 317 cwt. 12 lbs?

6. Required the cloff on 85 cwt. 2 qrs?

7. Required the net weight of 6786 cwt. 2 qrs. after deducting the tare at 18 lb. per cwt. and the usual tret and cloff?

8. How many gallons of oil are in 14 casks, each 3 cwt. 2 qrs. allowing tare at 15 lb. per cwt. and 7½ lb. net to the gallon?

9. What should be paid for 7308 lb. iron, allowing 1 lb. gratis to the score, at 3s. 8d. per stone of 16 lb.

10. How much pure gold is in a mass of 78 lbs. allowing 24 dwt. of alloy for each lb. of mass?

COMMISSION AND BROKERAGE.

Commission is the allowance charged by agents for buying or selling goods, negotiating bills, &c.

Brokerage is the charge for procuring sales, insurance, or transfer of property.

Commission, brokerage, premium on insurance, and, in general, all charges made by an agent for doing business, are reckoned at so much for £100, called the rate.

RULE. Multiply by the rate and divide by 100; or take the same part of the value that the rate is of £100.

NOTE. If the rate is in guineas, divide the value by 20, and add the quotient to the dividend, and proceed with the sum as if the rate was pounds.

1. What is the commission on £1764, 16s. 6d. at 3½ per cent.?

£1764, 16s. 6d.
3½

	882	8	3
	5294	9	6
100)£61	76	17	9
	20		
15	37		
	12		
4	53		
	4		
2	12		

Ans. £61, 15s. 4½d. $\frac{12}{100}$.

2. What is the commission on £436, 13s., at $2\frac{3}{4}$ per cent.?

3. What is the commission on £853, at $1\frac{7}{12}$ per cent.?

4. What is the commission on £1242, at 2s. 6d. per cent.?

5. What is the commission on £598, at 4s. 8d. per cent.?

6. Brokerage on £3560, at $\frac{1}{8}$ per cent.?

7. Brokerage on £1870, at $\frac{3}{4}$ per cent.?

8. Required the brokerage for procuring insurance to the amount of £2840, at $\frac{1}{4}$ per cent.?

9. What is the tax on £464, 16s. value of property, at $9\frac{1}{2}$ per cent.?

10. What is the commission on £6240, at $3\frac{1}{2}$ guineas per cent.?

INSURANCE.

Insurance is a contract in which the underwriter engages to repay the losses, on specified property, sustained by the insured, in consideration of a certain allowance called premium.

CASE 1. To find the premium, work as in commission.

NOTE. To find the sum recovered, subtract the premium, policy, charges, &c. from the amount of the loss.

1. What should be paid for insuring property to the amount of £1940, at $3\frac{3}{8}$ per cent.?

2. What should be paid for insuring property to the amount of £2736, at $5\frac{1}{2}$ guineas per cent.?

3. Insured £1560 upon a ship, at $4\frac{1}{2}$ guineas per cent., and the loss sustained amounted to £560; what will be recovered, allowing 2 per cent. discount on the loss?

4. Insured £4000 upon a ship, at $5\frac{1}{4}$ guineas per

cent., and policy 5s. per cent.; she received damage to the amount of £1500; how much will be recovered, allowing $2\frac{1}{4}$ per cent. discount on the loss?

CASE 2. To find how much must be insured to recover a given sum, in case of total loss.

RULE. Subtract the rate, and other charges, from 100, then multiply the sum to be recovered by 100, and divide by the difference.

5. How much must be insured at $4\frac{1}{2}$ guineas per cent., to recover £1250 in case of loss?

6. What must be insured at $5\frac{3}{4}$ per cent. on goods worth £1938, 12s. 6d., so that in case of loss the owner may recover their full value?

7. What sum must be insured at $4\frac{1}{4}$ guineas per cent. brokerage $\frac{1}{4}$ per cent., policy $\frac{3}{8}$ per cent., charges $2\frac{1}{2}$ per cent., in order to recover £3600?

8. What sum must be insured at $3\frac{3}{4}$ guineas per cent., brokerage $\frac{1}{8}$ per cent., policy 5s. per cent., and charges $1\frac{3}{4}$ per cent., in order to recover £8000?

NOTE. A duty is charged, on all sums insured, at the rate of 3s. per cent., and higher on foreign voyages. In time of war a high premium is required, but part of it is returned provided the ship sails with convoy and arrives.

9. In the time of war £1000 were insured from Antigua to London, at 12 guineas per cent., duty 5s. per cent. The ship sails with convoy and arrives, in which case 5 guineas per cent. are returned; what should the insured pay?

10. Insured 50 hhds. sugar at £30, from Jamaica to Liverpool, at 12 guineas per cent., duty 5s. per cent., but as the ship sailed with convoy and arrived, 6 guineas per cent. were returned; and it appeared that only 45 hhds. were shipped, and a general average is claimed at £1, 7s. 5d. per cent.; what balance is to be paid?

NOTE. The insurer claims 10s. per cent. upon the value of the 5 hhds. not shipped.

STOCKS.

Stock is the capital of a bank or trading company, or it is the debt owing by government, called the public funds.

Government stock has different names, as the three per cent. consolidated, the three per cent. reduced, &c.; the numbers show the rate of interest paid by government. This interest is paid half-yearly; that on the consols on the 5th of January and 5th of July, and that on the reduced on the 5th of April and 10th of October.

These stocks are bought and sold at a certain rate for £100 of them.

CASE I. To find the value of a given quantity of stock.

RULE. Multiply the quantity by the rate, and divide the product by 100.

NOTE. Brokers are always employed in transfers of stock and they charge one-eighth per cent. for their trouble; the brokerage is found as before, and added to it.

CASE II. To find the quantity of stock which can be purchased for a given sum.

RULE. Multiply the value by 100, and divide by the rate, and from the quotient subtract the brokerage found upon it.

1. What is the price of £1460 three per cent. consols at 72½ per cent., brokerage ⅛ per cent.?
2. What quantity of 4 per cents. at 93½ per cent. can be purchased for £950?
3. What is the value of £3400 bank-stock at 213¼ per cent.?
4. How much India stock at 178½ per cent. can be purchased for £2400?
5. How much 3 per cent. consols at 61 per cent. can be purchased for £750?
6. How much a-year can I purchase in the long

annuities for £1000, the price being at 17½ years' purchase?

INTEREST.

Interest is the allowance given by the borrower to the lender for the use of his money. It is reckoned at a certain rate on every £100 for a year.

The money lent is called the *principal*, and when the interest is added to it, the sum is called the *amount*.

CASE I. To find the interest for any number of years.

RULE. Multiply the principal by the years and by the rate, and divide by 100.

NOTE. For months take aliquot parts of a year.

CASE II. To find the interest for days.

RULE. Multiply by the days and by twice the rate, and divide by 73,000.

NOTE. Instead of multiplying by the rate and dividing by 100, and by the days in a year, or by 36,500, we, for ease, take their doubles.

1. What is the interest of £825 for 1 year, at 3 per cent.?
2. What is the interest of £387, 15s. 8d. for 7 years, at 5 per cent.?
3. What is the interest of £4268, 14s. for 3½ years, at 4 per cent.?
4. What is the interest of £2346 for 9 years 7 months, at 4¾ per cent.?
5. What is the interest of £36, 17s. 7d. for 9 months, at 4⅓ per cent.?
6. What is the interest of £1240 for 19 weeks, at 3 per cent.?
7. What is the interest of £780, 14s. 9½d. for 36 days, at 4 per cent.?
8. What is the interest of £630 from September 16th, to January 23d, at 4¼ per cent.?

9. What is the interest of £374, 5s. from April 1 to December 29, at 4 per cent.?

10. What is the interest of £593, 12s. 6d. from June 9 to December 6, at 4 per cent.?

CASE III. To find the interest when partial payments are made.

RULE. Multiply the principal and the successive balances by the number of days between the times of payment, add the products, and multiply the sum by twice the rate, and divide by 73,000.

11. Required the interest at $4\frac{1}{2}$ per cent, on a bill for £456, which became due May 7, and there were paid £120 on June 18, £116 September 27, £136 November 17, and the balance December 27.

Dates.	Sums.	Days.	Products.
May 7.	Due £456	42	912
June 18.	Paid 120		1824
	Bal. 336	101	336
Sept. 27.	Paid 116		336
	Bal. 220	51	220
Nov. 17.	Paid 136		1100
	Bal. 84	40	3360
Dec. 27.	Paid 84		
			67668
			9
			73,000)609,012

Ans. £8, 6s. $10\frac{4\,2\,2}{8\,2\,5}$d.=8.343 int.

12. Borrowed March 20, 1825, £1000, of which I paid £300 Sept. 17, £150 Dec. 21, £220 Feb. 23, 1826, the balance was paid July 23. What was then due, principal and interest, at 4 per cent.?

13. Required the interest on a bill of £2000, due Jan. 20, 1830, of which £350 were paid April 7, £690 Sept.

28, £420 Dec. 18, and the balance April 7, 1831, at 4½ per cent?

CASE IV. When the intervals are greater than a year, as on bonds, &c.

RULE. Find the interest due at each time of payment, add it to the principal, and from the sum subtract the payment.

14. A lent upon bond to B at 5 per cent. June 1, 1822, £750, and B has made the following payments, viz. Oct. 8, 1823, £180; Jan. 1, 1825, £360; and the balance Aug. 14, 1826; what was then paid?

15. Borrowed £1200 per bond due March 14, 1818, and paid the following instalments, viz. July 19, 1820, £490; August 13, 1821, £350; March 30, 1823, £500; the balance was paid November 11, 1825; how much was then paid at 4½ per cent.?

CASE V. To compute interest on accounts-current.

RULE. Write the sums under one another in the order of their dates, add them when both are received or both paid, and subtract them when one is received and the other paid, giving to the sum or remainder the name of the greater; then find the days, and multiply by them as before, placing the products of sums received in one column, and those of sums paid in another; then add each column, and multiply its sum by the double of its rate, and divide the difference of the products by 73,000.

NOTE. In drawing out an account-current the interest is written under the debit side of the person who owes it, then the balance is found and written under the less side.

16. Required the interest on the following account to the 12th of December, allowing 4 per cent. on sums due to Bell, and 3 per cent. on those due to Kidd.

Dr. John Bell in account-current with W. Kidd. *Cr.*

Feb. 11. To balance,	£186 0 0		Mar. 24. By flour,	£167 0 0	
26. To sugar,	215 0 0		Apr. 6. By cash,	348 0 0	
Jun. 20. To rum,	415 0 0		Sept. 26. By bill,	200 0 0	
Interest due by Bell,	3 8 11		By balance,	104 8 11	
	£819 8 11			£819 8 11	

	Dr. or Cr.	Sums.	Days.	Dr. Products.	Cr. Products.
Feb. 11.	Dr	£186	15	930	
Feb. 26.	Dr	215		186	
	Dr	401	26	2406	
Mar. 24.	Cr	167		802	
	Dr	234	13	702	
April 6.	Cr	348		234	
	Cr	114	75		570
June 20.	Dr	415			798
	Dr	301	98	2408	
Sept. 26.	Cr	200		2709	
Dec. 10.	Dr	101	75	7575	
			To Kidd,	53331 6	8550 to Bell. 8
				319986	68400
				68400	
			73,000)	251,586	

Int. due by Bell, £3, 8s. 11 $\frac{24.1}{182.5}$ d.

17. Required the interest and the balance due on the following account to the 30th of April, 1825, allowing 5 per cent. when the balance is due to the bank, and 3 per cent. when due to Miln.

Dr. Thomas Miln in acct.-curt. with the Royal Bank. *Cr.*

Mar. 8.	To balance, £240	June 18. By bill,	£516
July 8.	To cash, 222	Sept. 23. By cash,	294
Oct. 29.	To cash, 432	Nov. 15. By bill,	444
Dec. 17.	To cash, 651	Feb. 18. By cash,	450

Ans. Int. £2, 7s. 2½d. Bal. due £156, 12s. 9½d.

CASE VI. To find the discount on bills.

RULE. Find the number of days from that on which the bill is discounted to the day on which it falls due,

including three days of grace, and the *interest* found for that time is what is called its *discount*.

NOTE. When the term of a bill is expressed in months, calendar months are understood; thus, if a bill at two months is dated December 29, 30, or 31, the term expires on February 28 in common, or on February 29 in leap years.

18. A bill of £400, dated 29th March, at 3 months, was discounted 10th April; what was the discount?

19. A bill of £729, dated May 15, at 4 months, was discounted July 1; how much did the holder receive?

20. A bill of £328, dated August 24, at 6 months, was discounted September 30; besides interest at 4½ per cent. the banker charged ½ per cent. commission; how much did the holder receive?

VULGAR FRACTIONS.

1. A fraction is one or more *parts* of a thing, and supposes the unit or integer to be divided into a number of equal parts.

2. A fraction is expressed by two numbers, one above the other, with a line between them, as $\frac{1}{3}$, $\frac{3}{8}$, $\frac{5}{12}$.

3. The under number is called the *denominator*, and shows into how many parts the unit is divided.

4. The upper number is called the *numerator*, and shows how many such parts are contained in the fraction.

NOTE. $\frac{4}{7}$ may be read $\frac{4}{7}$ of 1 or $\frac{1}{7}$ of 4.

5. A *proper fraction* is one of which the numerator is less than the denominator, as $\frac{3}{7}$, $\frac{8}{11}$.

6. An *improper fraction* is one of which the numerator is equal to or greater than the denominator, as $\frac{7}{7}$, $\frac{12}{7}$.

7. A compound fraction consists of two or more fractions connected with the word *of*, as $\frac{2}{3}$ of $\frac{4}{5}$,

8. A mixed number consists of an integer and a fraction, as $7\frac{3}{5}$.

9. The greatest common measure of two or more numbers is the greatest number that will divide each of them without a remainder.

10. The least common multiple of several numbers, is the least number that each of them will divide without a remainder.

NOTE. A fraction is not altered in value by multiplying or dividing both its terms by the same number. It is increased by increasing the numerator, or by diminishing the denominator, and it is lessened by increasing the denominator, or lessening the numerator. Upon this principle all the following rules are founded.

REDUCTION.

I. To reduce an improper fraction to a whole or mixed number.

RULE. Divide the numerator by the denominator; the quotient is the whole number, and the remainder, with the divisor below it, is the fraction.

Reduce to integers $\frac{20}{15}$, $\frac{119}{17}$, $\frac{117}{13}$, $\frac{168}{14}$, $\frac{365}{73}$, $\frac{1860}{93}$, to mixed numbers $\frac{77}{3}$, $\frac{364}{5}$, $\frac{38}{7}$, $\frac{479}{18}$, $\frac{325}{43}$, $\frac{479}{37}$.

II. To reduce a mixed number to an improper fraction.

RULE. Multiply the integer by the denominator, taking in the numerator, and place the denominator below it.

NOTE. An integer has one for its denominator.

Reduce to improper fractions 6, 1, 9, $25\frac{2}{3}$, $72\frac{4}{5}$, $7\frac{3}{8}$, $25\frac{3}{13}$, $219\frac{1}{12}$, $147\frac{8}{17}$.

III. To reduce a compound fraction to a simple one.

RULE. Multiply all the numerators together, for the numerator, and all the denominators for its denominator.

Reduce to simple fractions $\frac{3}{8}$ of $\frac{4}{15}$, $\frac{4}{7}$ of $\frac{5}{12}$ of 7, $\frac{3}{7}$ of $\frac{5}{12}$ of $\frac{1}{8}$, $\frac{3}{4}$ of $\frac{5}{8}$ of $7\frac{3}{4}$, $\frac{6}{7}$ of $\frac{11}{12}$ of $\frac{1}{9}$ of $6\frac{3}{8}$, $\frac{3}{11}$ of $\frac{8}{9}$ of $\frac{4}{17}$ of $5\frac{1}{8}$, $\frac{7}{15}$ of $\frac{8}{19}$ of $\frac{3}{4}$ of 16.

IV. To reduce a fraction to its lowest terms.

RULE. Divide both terms by their greatest common measure. This measure is got by dividing the greater by the less, and the divisor by the remainder continually, and the divisor, which leaves no remainder is the measure required by which to divide both terms.

Or divide by any number which measures both terms.

NOTE 1. 5 measures any number ending in 5 or 0, 2 measures any number when it measures the last figure, 4 when it measures the two last, 8 when it measures the three last, 3 or 9 if they measure the sum of the digits, and 11 when the sums of its alternate digits are equal.

NOTE 2. To find the greatest common measure of three or more numbers. Find that of the first and second as in the rule, then find the greatest common measure of this and the third number, and so on.

Reduce to their lowest terms,

1. $\frac{75}{430}$.
2. $\frac{176}{484}$.
3. $\frac{176}{1000}$.
4. $\frac{679}{1746}$.
5. $\frac{272}{425}$.
6. $\frac{5170}{8734}$.
7. $\frac{12363}{16332}$.
8. $\frac{2857144}{9999999}$.
9. $\frac{82880}{113855}$.

V. To find the least common multiple of several numbers.

RULE. Arrange the given numbers in one line, and divide the greatest number of them by any number that will leave no remainder; place the quotient and the numbers not divided in a line under the former; divide this line as before, and so on till all the quotients are 1; the product of all the divisors is the common multiple required.

Required the least common multiple of,

1. 7, 14, and 28.
2. 14, 18, and 24.
3. 32, 44, and 52.
4. 13, 65, and 48.
5. 8, 6, 14, and 28.
6. 9, 12, 15, and 30.
7. 8, 7, 36, and 56.
8. 9, 15, 45, and 75.

VI. To reduce fractions to others of equal value which have a common denominator.

RULE. Multiply each of the numerators into all the denominators except its own for the new numerators, and multiply all the denominators together for the common denominator.

NOTE. The numerators, after reduction, show their relative values.

Reduce to a common denominator,

1. $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{4}$.
2. $\frac{5}{6}$, $\frac{4}{5}$, and $\frac{11}{8}$.
3. $\frac{7}{11}$, $\frac{8}{9}$, and $\frac{6}{18}$.
4. $\frac{6}{7}$, $\frac{5}{6}$, and $4\frac{2}{3}$.
5. $\frac{1}{2}$ of $\frac{3}{4}$, $\frac{2}{3}$, and $\frac{3}{5}$.
6. $\frac{4}{5}$, $\frac{3}{7}$, $\frac{13}{15}$, and $\frac{16}{17}$.

VII. To reduce fractions to their least common denominator.

RULE. Find the least common multiple of the denominators for the new denominator, then divide it by each of the given denominators, and multiply the several quotients by the respective numerators for the new numerators.

Reduce to their least common denominator,

1. $\frac{3}{4}$, $\frac{5}{8}$, $\frac{11}{12}$, and $\frac{7}{16}$.
2. $\frac{3}{5}$, $\frac{7}{15}$, $\frac{5}{18}$, and $\frac{3}{25}$.
3. $\frac{2}{3}$, $\frac{3}{8}$, $\frac{5}{16}$, and $\frac{13}{36}$.
4. $\frac{3}{7}$, $\frac{5}{8}$, $\frac{2}{14}$, and $\frac{13}{28}$.

VIII. To reduce a fraction from one name to another.

RULE. If to a higher name, multiply the denominator by the value of the higher; if from a higher to a lower, multiply the numerator by the value of the higher; the other term is the same as before.

Reduce the following:

1. $\frac{4}{9}$ farthing to the fraction of a pound.
2. $\frac{4}{105}$ guinea to the fraction of a shilling.
3. $\frac{7}{8}$ penny to the fraction of a guinea.
4. $\frac{1}{2016}$ cwt. to the fraction of an oz.

5. £$\frac{4}{5}$ to the fraction of a guinea.
6. $\frac{5}{12}$ joannes to the fraction of a £
7. $\frac{5}{8}$ lb. to the fraction of a ton.
8. $\frac{2}{13}$ yd. to the fraction of a mile.
9. $\frac{4}{7}$ per. to the fraction of an acre.
10. $\frac{1}{144}$ ac. to the fraction of a yard.
11. $\frac{3}{5}$ moid. to the fraction of a joan.
12. $\frac{8}{9}$ dwt to the fraction of a lb.

IX. To reduce a lower name to the fraction of a higher.

RULE. Make the lower name, or the quantity reduced to its lowest name, the numerator, and the value of the higher expressed in the same name the denominator.

Reduce the following:

1. 9$\frac{3}{4}$d. to the fraction of a guinea.
2. 7s. 8$\frac{1}{2}$d. to the fraction of a £.
3. 4$\frac{1}{2}$d. to the fraction of a shilling.
4. 4 lb. 3 dr. to the fraction of a cwt.
5. 7$\frac{3}{4}$ drs. to the fraction of a lb. avoird.
6. 3 ro. 5 per. to the fraction of an acre.
7. 7 fur. 4 po. to the fraction of a mile.
8. 3 bu. 3 pec. to the fraction of a quarter.
9. 18 hr. 10 min. to the fraction of a day.
10. 125 da. 15 ho. to the fraction of a com. year.
11. 12 dwt. 8 gr. to the fraction of a lb. Troy.
12. 20 lb. 4 oz. to the fraction of a ton.

X. To find the value of a fraction.

RULE. Reduce the numerator to the next inferior name, and divide by the denominator; reduce the remainder to the next lower, and divide again, and so on.

Find the value of,

1. £$\frac{7}{240}$.
2. $\frac{3}{8}$s.
3. £$\frac{59}{60}$.
4. $\frac{13}{336}$ guinea.
5. $\frac{37}{320}$ qr.
6. $\frac{43}{13200}$ ml.
7. $\frac{25}{32}$ ac.
8. $\frac{7}{48}$ crown.
9. $\frac{1}{160}$ hour.
10. $\frac{61}{96}$ day.
11. $\frac{33}{726}$ lb. Tr.
12. $\frac{53}{4480}$ ton.

ADDITION.

RULE. Reduce the fractions to a common denominator if they have not one, then add the numerators, and under their sum write the common denominator.

NOTE 1. If the answer is an improper fraction, reduce it to a whole or mixed number.

NOTE 2. When mixed numbers are given, find the sum of the fractions, and to it add the integers.

NOTE 3. When fractions are of different names, reduce them to the same name, and add as before.

What is the sum of

1. $\frac{7}{13}$, $\frac{11}{12}$, $\frac{23}{13}$, $\frac{24}{13}$?
2. $\frac{2}{9}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$?
3. $\frac{5}{16}$, $\frac{7}{8}$, $\frac{14}{15}$, $\frac{13}{27}$?
4. $\frac{3}{17}$, $\frac{4}{9}$, $\frac{1}{5}$, $\frac{6}{19}$?
5. 6, $9\frac{1}{4}$, 8, $11\frac{1}{3}$?
6. $6\frac{3}{11}$, $\frac{7}{8}$, $14\frac{1}{3}$, $51\frac{3}{4}$?
7. $\frac{3}{8}$c., £$\frac{5}{12}$, $\frac{8}{15}$g.?
8. $\frac{3}{5}$q. $\frac{2}{3}$b. $\frac{2}{5}$p.?

SUBTRACTION.

RULE. Reduce the fractions as in Addition, then subtract the numerators, and under the difference write the common denominator.

NOTE 1. In mixed numbers, first subtract the fractions, and if the numerator of the subtrahend is the greater, take it from the common denominator, and add the remainder to the numerator of the minuend, for the numerator of the remainder, then add one to the units' place of the subtrahend.

NOTE 2. Fractions of different names must be reduced to the same.

What is the difference between,

1. $\frac{4}{5}$ and $\frac{5}{12}$?
2. $\frac{24}{25}$ and $\frac{16}{49}$?
3. $\frac{2}{11}$ and $\frac{1}{13}$ of $\frac{4}{7}$?
4. $6\frac{1}{8}$ and $4\frac{3}{4}$?
5. 15 and $\frac{3}{7}$?
6. $13\frac{7}{8}$ and $4\frac{4}{5}$?
7. £$\frac{7}{11}$ and $\frac{7}{12}$s.?
8. £$\frac{12}{15}$ and $\frac{4}{7}$cr.?

MULTIPLICATION.

Rule. Reduce integers and mixed numbers to improper fractions, then multiply all the numerators together for the numerator of the product, and all the denominators together for its denominator.

Multiply,

1. $\frac{1}{12}$ by $\frac{4}{5}$.
2. $8\frac{3}{4}$ by $\frac{5}{12}$.
3. $\frac{9}{11}$ by $\frac{7}{11}$ of $\frac{5}{8}$.
4. $5\frac{3}{8}$ by $11\frac{1}{4}$.
5. $17\frac{5}{11}$ by $7\frac{5}{18}$.
6. 8 by $\frac{5}{7}$.
7. £$2\frac{3}{11}$ by $\frac{3}{7}$.
8. $60\frac{2}{5}$ g. by $50\frac{4}{6}$.

DIVISION.

Rule. Reduce as in multiplication, then invert the divisor, and proceed as in multiplication.

Divide,

1. $\frac{11}{15}$ by $\frac{11}{12}$.
2. $3\frac{31}{48}$ by $\frac{5}{12}$.
3. $14\frac{7}{15}$ by $17\frac{3}{11}$.
4. 12 by $\frac{8}{4}$.
5. $\frac{56}{165}$ by $\frac{8}{9}$ of $\frac{3}{5}$.
6. £$980\frac{7}{11}$ by $21\frac{3}{7}$.
7. $17\frac{25}{48}$ by $4\frac{5}{6}$.
8. $\frac{1}{2}$ of $\frac{4}{7}$ by $\frac{2}{3}$ of $\frac{3}{5}$.

PROMISCUOUS EXERCISES.

1. Required the greatest common measure of 306, 408, and 374.
2. Reduce $\frac{378}{13}$ to a whole or mixed number.
3. Reduce $375\frac{24}{99}$ to an improper fraction.
4. Reduce 15 to an improper fraction.
5. Reduce 14 to a fraction with 8 for the denominator.
6. Reduce $\frac{5}{6}$ of $\frac{5}{9}$ of $\frac{27}{101}$ to a simple fraction in its lowest terms.
7. Reduce $\frac{83}{97}\frac{43}{47}$ to its lowest terms.
8. Reduce $\frac{12}{21}$, $\frac{15}{27}$, $\frac{9}{24}$, $\frac{21}{36}$, to a common denominator.
9. Reduce $\frac{2}{7}$ of $\frac{2}{3}$ of $\frac{5}{8}$, and $\frac{3}{4}$ of $\frac{4}{7}$ of $\frac{2}{5}$, to a common denominator.

10. Reduce 3s. $5\frac{1}{9}$d. to the fraction of a crown.

11. Reduce $\frac{2}{3}$ of $\frac{3}{4}$d. to the fraction of a shilling.

12. What is the value of $\frac{5}{9}$ of £$\frac{1}{8}$?

13. What is the value of $\frac{1}{2}$ of $\frac{6}{5}$ lb. troy?

14. Bought $4\frac{3}{5}$ cwt. tea, then $24\frac{5}{8}$ lbs. and $13\frac{1}{2}$ oz.; how much in all?

15. A man had $\frac{1}{3}$ of a ship, and sold $\frac{3}{4}$ of his share; how much remained?

16. What is the value of $7\frac{5}{9}$ cwt. tobacco at £$12\frac{5}{6}$ per cwt.?

17. A farm of $94\frac{5}{6}$ acres, was rented for £$450\frac{1}{3}$; what was the rent per acre?

18. What is the difference between $\frac{3}{5}$ yard, and $\frac{2}{7}$ ell English?

19. What cost $5\frac{3}{7}$ oz. silver at £$4\frac{3}{8}$ per lb.?

20. If $\frac{7}{12}$ ship cost £$953\frac{1}{4}$, what will $\frac{3}{8}$ of her cost?

21. If $13\frac{3}{4}$ yds. of cloth $\frac{5}{8}$ yd. wide, cost £$10\frac{2}{3}$, how much cloth $\frac{7}{4}$ yd. wide, can be bought for £$74\frac{2}{3}$?

22. A can do a piece of work in 4 weeks, B can do the same in 6 weeks, and C in 10 weeks; in what time will they do it working all together?

23. A, B, and C can do a piece of work in 8 days, which A and B can do in 12 days, and B and C can do in 16 days; in what time could each do it separately?

24. A and B can perform a piece of work in 8 days, A and C can do the same in 12 days, and B and C in 16 days; in what time could each separately perform it, and also when working all together?

25. What number is that to which if we add $\frac{2}{7}$ of $\frac{5}{9}$ the sum will be 1?

DECIMAL FRACTIONS.

A decimal fraction is that which has 1 with one or more ciphers for its denominator, as $\frac{7}{10}$, $\frac{89}{1000}$, so that the unit is divided into 10 or 100 or 1000, &c. equal parts. The numerator only is written with a point on

the left hand of it. It must have as many places as the denominator has ciphers; if not, the deficient places are supplied by prefixing ciphers to it. Thus the denominator will consist of 1, with as many ciphers as the numerator has places, as ·7 or $\frac{7}{10}$, ·29 or $\frac{29}{100}$, ·038 or $\frac{38}{1000}$.

A cipher on the left diminishes the value of the significant figures ten times, but on the right it makes no alteration.

REDUCTION.

1. To reduce a vulgar fraction to a decimal.

RULE. Annex ciphers to the numerator, and divide by the denominator, and in this way carry on the work till there is no remainder, or till the same figure or figures come to be repeated in the quotient. The number of ciphers used point out the number of decimal places in the quotient.

NOTE. If the division terminates without a remainder, the decimal is said to be *terminate* or *finite*; if not, it is called *interminate*. When an interminate decimal repeats constantly the same figure, it is called a *repeater*, and when it repeats several figures in the same order, it is called a *circulate*. The repeater or circulate is said to be *pure* when the repeating figures begin at the decimal point, and *mixed* when there are other figures before them.

NOTE 2. A repeater is denoted by a point above it, and a circulate by a point above its first and last figures.

1.	Red. $\frac{1}{8}$ to a dec.	7.	Red. $\frac{1}{8}$ to a dec.
2.	$\frac{3}{4}$	8.	$\frac{5}{6}$
3.	$\frac{2}{5}$	9.	$\frac{19}{44}$
4.	$\frac{7}{16}$	10.	$\frac{23}{37}$
5.	$\frac{4}{9}$	11.	$\frac{4}{7}$
6.	$\frac{7}{11}$	12.	$\frac{5}{13}$

II. To reduce a terminate decimal to a vulgar fraction.

RULE. The figures of the decimal make the numerator, and the denominator is one with as many ciphers annexed as there are places in the numerator. It must be reduced to lower terms when possible.

1.	Red. ·4 to a frac.	5.	Red. ·34 to a frac.
2.	·75	6.	·5625
3.	·625	7.	·036
4.	·005	8.	·6015625

III. To reduce a lower name to the decimal of a higher.

RULE. Annex ciphers to the given number of the lower name, and divide by the value of the higher, pointing as many decimals in the quotient as there are ciphers used. If the number consists of several lower names, reduce the lowest to a decimal of the next higher, and prefix the number of that higher; reduce the number thus obtained to a decimal of the next higher, and so on.

Reduce,

1. 9d. to the decimal of a shilling.
2. 4s. to the decimal of a pound.
3. 7s. to the decimal of a guinea.
4. 7 lb. to the decimal of a cwt.
5. 3 qrs. to the decimal of a yard.
6. 11d. to the decimal of a shilling.
7. 9d. to the decimal of a pound.
8. 12s. 6d. to the decimal of a pound.
9. 18s. 11d. to the decimal of a pound.
10. 14s. 3½d. to the decimal of a pound.
11. 11 oz. 17 dwt. to the decimal of a lb. troy.
12. 18 cw. 13 lb. to the decimal of a ton.
13. 7 oz. 14 dr. to the decimal of a cwt.
14. 6 fu. 4 po. to the decimal of a mile.
15. 5 yd. 5 in. to the decimal of a pole.
16. 7 ho. 9 m. to the decimal of a day.

IV. To find the value of a decimal.

RULE. Multiply by the number of the next lower, which makes one of the given name, and point as many decimals in the product as are given; multiply these decimals by the value of that name, and point as before, and so on.

Value,

1. £·875.	9. ·875 yd.
2. £·725.	10. ·675 acre.
3. £·0375.	11. ·625 gall.
4. £·634375.	12. ·765625 ml.
5. ·9167s.	13. ·984725 qr.
6. ·0714286 cw.	14. ·29792 day.
7. ·0075893 ton.	15. ·2778 guin.
8. ·05695 lb. tr.	16. ·01986 yr.

CONTRACTIONS.

I. To reduce shillings, pence, and farthings to the decimal of a pound by inspection.

RULE. Take half the number of shillings for the first decimal place; reduce the pence to farthings, and add one if it amounts to 24 or more, and also add 50 if there is an odd shilling for the two next places.

To complete the decimal, call these two figures or their excess above 25, 50, or 75 so many pence, and bring them to farthings, adding 1 for every 24 in them, which will give other two figures, and so on.

Reduce to the decimal of a pound,

1. 8s. 8½d.	5. 19s. 11¾d.
2. 15s. 6d.	6. 9¾d.
3. 13s. 5½d.	7. 2¼d.
4. 17s. 9¾d.	8. 1¼d.

II. To value the decimal of a pound sterling by inspection.

RULE. Take double the first decimal place for shillings, but when the second is 5 or upwards, take 5 from it, and add 1 to the shillings, then the second and third figures, or their excess above 50, are farthings, after deducting 1 if they amount to 25 or upwards.

Find the value of

1. £·225.
2. £·536.
3. £·446.
4. £·678.
5. £·904.
6. £·073.
7. £·009.
8. £·4981.

ADDITION.

Rule. Write the numbers so that the points shall be directly under one another, and, disregarding the points, add as in integers, and in the sum place the point directly under the other points.

1. Add 478·63, 89·005, ·00125, 5437·25.
2. Add 7·548, ·0009, 6·75, ·502, 89·5.
3. Add ·04, ·614, 4·21, 73·6, ·00047.
4. Add 740·86, 3·74009, 6847, ·004862, 7465·384, 5·76, 3·874, 74863.
5. Add £22, 17s. 6d., £0·525, £8, 8s. 6d., £48·875, £0·0095, £16, 5s. 3d., £93·4028.
6. Add £475, 12s. 6d., £786, 19s. 9d., £7·00475, £54·7257, £45, 9s. 6d., £3275, 17s. 3d., £·00074, £472·07386, £0, 3s. 6d.

SUBTRACTION.

Rule. Write the numbers as in addition, and subtract as in integers.

1. From 83·25 take 7·4825.
2. From 9·342 take ·00375.
3. From ·0098 take ·000071.
4. From $18\frac{1}{2}$ take 7·854.
5. From £346·892 take £108·90754.
6. From £507, 18s. 9d. take £219, 7s. 6d.

MULTIPLICATION.

RULE. Work as in integers, without regarding the points, then point as many decimals in the product as are in both factors; if there are not so many, prefix ciphers.

NOTE. To multiply a decimal by 1 with ciphers, remove the point to the right as many places as the number of ciphers.

1. Multiply ·987 by ·642.
2. Multiply 8914·714 by 6·7.
3. Multiply ·0714 by ·013.
4. Multiply 74·58 by ·083.
5. Multiply ·078 by ·004.
6. Multiply 478 by ·038.
7. Multiply 71·807 by ·0009.
8. Multiply 78·54 by 1000.

DIVISION.

RULE. Divide as in integers, and point the quotient so that the number of decimal places in the quotient and divisor together shall be equal to those in the dividend; if there are not so many, prefix ciphers to the quotient.

NOTE 1. If the dividend has not so many decimals as the divisor, annex ciphers to it before dividing.

NOTE 2. When there is a remainder, annex ciphers to the dividend, and carry on the division.

NOTE 3. To divide by 1 with ciphers, remove the point to the left as many places as there are ciphers.

1. Divide ·1206 by ·15.
2. Divide ·504020944 by ·8204.
3. Divide ·04888501956 by ·01548.
4. Divide 87486·125 by ·75.
5. Divide ·1728 by 12.
6. Divide 153·2 by ·64.
7. Divide ·0486241 by 17·9.
8. Divide 34·72 by 1000.

PROMISCUOUS EXERCISES.

1. If $7\frac{5}{6}$ hhds. rum cost £$422\frac{5}{11}$, what is that per gallon?

2. What cost 3 chests tea, each 3 cwt. 14 lb., at 5s. 7d. for $1\frac{1}{3}$ lb.?

3. How many yards of cloth, at 8s. 4d. per yd., must be given for 223 ells Eng., at 8s. 4d. $\frac{4}{5}$ per yd.?

4. If when wheat is at 5s., the $2\frac{1}{2}$d. loaf weighs $8\frac{2}{5}$ oz., what ought the 6d. loaf to weigh when wheat is at 8s. 3d.?

5. What is the interest of £83, 13s 8d. for $\frac{5}{18}$ year, at $4\frac{5}{8}$ per cent.?

6. What sum must be put to interest just now at $4\frac{1}{2}$ per cent., that the interest may pay a debt of £$29\frac{3}{4}$, due $1\frac{1}{3}$ year hence?

7. Required the time in which 780 guineas will gain £$110\frac{10}{18}$ at $5\frac{1}{4}$ per cent.?

8. If $22\frac{1}{4}$ cwt. cost £97, 0s. $7\frac{1}{2}$d. what is that per cwt.?

9. If $15\frac{2}{5}$ hhds. sugar weigh 286 cwt. 3 qr. $8\frac{2}{5}$ lb., what will 1 hhd. weigh?

10. What is the interest of £$756\frac{1}{4}$ for $7\frac{1}{2}$ years at $4\frac{3}{4}$ per cent.?

DISCOUNT.

Discount is an allowance made for the payment of any sum of money before it becomes due.

RULE. First find the interest of £100 for the time before the money becomes due, and add it to 100 to get the amount of £100. Then to find the discount, say as the amount of £100 is to the interest of £100, so is the given sum to the discount. Subtract the discount from the given sum, the remainder is the present worth.

1. What is the discount on £800, due 9 months hence, interest at 4 per cent.?

2. What is the present worth of £270, 10s. 6d. due 1½ years hence, at 3½ per cent?

3. Bought cloth for 21s. per yard, and 9 months' credit; how much should I be allowed for present payment, interest at 4 per cent.?

4. Sold goods for £575, 17s. 6d. to be paid 215 days hence; what is their present worth, interest at 5 per cent.?

5. Bought goods for £600, and 8 months' credit, and am offered £40 discount for present payment; at what rate of interest is this offer made?

EQUATION OF PAYMENTS

Is to find the time when several debts due at different times may be paid at once.

RULE. Multiply each debt by the time which must elapse before it is due; then divide the sum of the products by the sum of the debts for the equated time nearly.

1. A owes me £150 in 40 days, £70 in 60 days, £200 in 105 days; at what time should he pay the whole at once?

2. I owe £200 in 6 months, £350 in 11 months, £700 in 13 months, and £730 in 16 months; when may I pay the whole?

3. £1000 is to be paid, £50 on the first day of each month till the whole is paid; required the equated time for paying it at once?

BARTER.

Barter is the exchanging of goods in such a manner that the value of those given away must be equal to the value of those received.

RULE. Find the value of the goods given away, and divide by the price of those received to find the quantity or divide by the quantity to find the price. In other cases work according to the nature of the question.

1. How much cloth, at 23s. 4d. per yard, should I get for 97½ cwt. of sugar, at 9¾d. per lb.?

2. Exchanged 156 yards of cloth, at 16s. 10d. per yard, for 936 yards of linen; what did the linen stand me per yard?

3. Exchanged 38 dozen pairs shoes, at 7s. 8d. per pair, and received equal quantities of raisins at 9½d. per lb., and figs at 5¼d. per lb.; how much of each did I receive?

4. Bartered 19 cwt. tobacco, at £8, 15s. per cwt. for hemp, at 10d. per lb., and flax, at 1s. 1d., and got 4 times as much flax as hemp; how much did I get of each?

5. B has 100 gals. of brandy worth 25s., which he wishes to exchange with A for wine worth 31s. 6d. per dozen, but A demands 36s. for his wine in barter; how should B rate his brandy to be equal with A, and how much wine will he receive?

PARTNERSHIP.

Teaches to divide the profits or losses of merchants in company, in proportion to their shares of the capital or stock, or to divide a number in given proportions.

RULE. As the whole stock is to each partner's share of it, so is the whole gain or loss to each partner's share of it. Or as the sum of the given numbers is to each particular number, so is the number to be divided to the parts required.

1. Divide 960 into parts, having the proportion of 1, 3, 5.

2. Three men make a joint-stock, of which A's share

is £64, B's £88, and C's £96; their profits amount to £108; what are their shares of it?

3. A, B, and C make a joint-adventure to India, A's share is £1500, B's £2160, and C's £1964; they gain £750; required the gain of each?

4. B, C, and D carry on a joint-trade with a capital of £4000; at the end of a year B's gain was £150, C's £200, and D's 120; required the stock of each?

5. A, B, C, D, and E found a purse of 100 sovereigns; A claims $\frac{1}{3}$, B $\frac{1}{5}$, C $\frac{1}{2}$, D $\frac{1}{6}$, and E $\frac{1}{7}$; but they find it too little: It is required, therefore, to find their shares of it in the above proportion?

NOTE. When the stocks in company continue unequal times, each must be multiplied by the time of its continuance.

6. A's stock of £250 was 3 months in trade, B's of £960, was 2 months, and C's of £540, was 6 months: they gained £480; what were their shares of it?

7. B and C enter into partnership for 12 months; B's stock is £500, and C's £720; after 5 months they admit D with a capital of £1000, and propose giving him one-third of the year's gain, which was £360; required whether D gained or lost by this arrangement, and also the gains of B. and C?

8. A, B, and C enter into company; A puts in at first, £2000, and at the end of 3 months £1000 more, but at the end of 7 months he withdraws £1500; B puts in at first £4000, but at the end of 6 months withdraws £3000; C puts in at first £1000, at the end of 3 months £1000 more, and at the end of 6 months £2000 more; at the end of 12 months their gain was £1000; required the share of each?

9. Three graziers rent a grass-field for 6 months, at £70. Now A pays £15, and puts in 30 oxen; B pays £24, and puts in 36 oxen; C pays the rest, and puts in 40 oxen; required the time that the oxen of each continued?

PROFIT AND LOSS.

The difference between the buying and selling prices is called *Gain* when the selling price is the greater, and *Loss* when it is the less.

CASE I. When the gain or loss on one article is given to find the gain or loss on the whole, multiply by the number of articles. When the whole gain or loss is given, to find the gain or loss on one article, divide by the number of articles. When the whole gain or loss, and that on one article, are given to find the quantity, divide by the gain or loss on one article.

1. Bought 428 yards cloth at 14s. 8d., and sold them at 16s. 3d.; what did I gain?

2. Bought 136 yds. muslin at 3s. 8d.; how must the yard be sold to gain £12?

3. Bought cloth at 17s. 6d.; how much of it must I sell at 19s. to gain £43, 13s. 6d.?

4. Sold 257 yards linen at 3s. 9d., and lost £9; what was the yard bought at?

5. Bought 257 cwt. sugar at £3, 3s. 6d. per cwt. and sold it at 7½d. per lb.; whether did I gain or lose, and how much?

6. Bought Brussels carpet at 3s. 10d. per yard; how many yards must I sell at 4s. 1⅛d. to gain £10

CASE II. Given the prime cost and the selling price, to find the profit or loss per cent.

RULE. As the prime cost is to the profit or loss on it, so is 100 to the profit or loss per cent.

7. Bought stockings at 3s. 8d., and sold them at 4s.; what was gained per cent.?

8. Bought tea at 5s. 6d., and sold it at 4s. 9d.; what was lost per cent.?

9. Bought figs at 14d. per lb., and sold them at £7, 2s. 6d. per cwt.; what was gained or lost on 49 cwt. and how much per cent.?

CASE III. Given the prime cost and rate per cent. profit or loss, to find the selling price.

RULE. As 100 is to 100, with the rate per cent. added to it in case of gain, but subtracted from it in case of loss, so is the prime cost to the selling price.

10. Bought linen at 2s. 3d.; how must it be sold to gain 5 per cent.?

11. Bought cloth at 15s. and lost 10 per cent. on it; what was it sold at?

12. Sold muslin at 4s. 9d., and gained 3 per cent; what was it bought at?

13. Sold linen at 9s., and gained $56\frac{1}{2}\frac{2}{3}$ per cent.; what was it bought at?

CASE IV. Given two selling prices, and the rate per cent. of one of them, to find the rate per cent. of the other.

RULE. As the price whose rate per cent. is given is to 100, with the rate added or subtracted, so is the other selling price to a fourth number, from which subtract 100 in case of gain, but which subtract from 100 in case of loss, for the required rate.

14. Sold tobacco at 4s., and gained 2 per cent., but it fell to 3s. 8d.; what was then gained or lost per cent.?

15. Sold butter at 10d. per lb., and thereby gained 25 per cent.; what did I gain or lose per cent. by selling it at $8\frac{1}{2}$d.?

16. By selling cheese at 60s. a cwt. I lost 16 per cent.; what will I gain or lose per cent. by selling it at 68s.?

17. Sold shoes at 8s., and lost 4 per cent.; how must they be sold to gain 5 per cent.?

CASE V. Given the whole gain or loss and the rate per cent. to find the prime cost and the selling price.

RULE. As the rate is to 100, so is the gain to the prime cost; and the selling price is got by adding the gain, or deducting the loss.

18. Gained £53, 14s. on 358 cwt. sugar sold at 3 per cent. profit; what was it bought and sold at per cwt.?

19. Sold 750 yards of muslin at 30 per cent. profit, and thereby gained £60; what was a yard sold at?

20. By selling 1000 lbs. of tea I gained £100, at the rate of 25 per cent.; what was a cwt. of it sold for?

21. By selling cloth at 15s. 6d per yard I gained 5 per ct.; what would I gain or lose per cent. by selling the same at 15s. and 6 months' credit?

22. I paid £30 a cwt. for tea 12 months ago; what will I gain or lose per cent. if I sell it now at 6s. 6d. per lb. and 6 months' credit?

INVOLUTION.

Involution is the method of finding the powers of numbers. A number is called the *first power* of itself, or the *root* of any higher power of it. A number multiplied by itself produces its *square* or *second power*. If this is again multiplied by the number, it produces the *cube* or *third* power, and so on.

TABLE OF POWERS.

Roots	1	2	3	4	5	6	7	8	9	10	11	12
Squares	1	4	9	16	25	36	49	64	81	100	121	144
Cubes	1	8	27	64	125	216	343	512	729	1000	1331	1728

1. Raise to the square 34, 127, $13\frac{1}{2}$, $\frac{5}{8}$, $11\frac{1}{4}$, ·00275.
2. Raise to the cube 16, 29, $36\frac{3}{4}$, $\frac{5}{6}$, ·0115.

EVOLUTION.

Evolution is the method of finding the roots of numbers.

TO EXTRACT THE SQUARE ROOT.

RULE. Divide the given number into periods of two figures, reckoning from the unit's place.

Find the greatest square contained in the left-hand period, place its root in the quotient, subtract the square from

that period, and to the remainder annex the second period for a dividend. Place twice the quotient or root for a divisor, by which divide the dividend, omitting the right-hand figure, and place the result on the right both of the root and the divisor. Multiply the divisor thus completed by this figure, subtract the product from the dividend, and to the remainder, bring down the next period for a new dividend, then for a new divisor add the figure last put in the root to the completed divisor, and proceed as before.

NOTE 1. If there is a remainder after all the periods are used, annex periods of ciphers, and continue the operation to decimals.

NOTE 2. The root of a fraction is got by taking the roots of its two terms, if it can be done exactly; if that cannot be done, reduce the fraction to a decimal, and extract the root as before.

1. Required the square root of 481636?

	48,16,36	(694 root.
	36	694
129)	1216	2776
9	1161	6246
1384)	5536	4164
	5536	481636 proof.

2.	20736?	9.	·000289?
3.	95023504?	10.	161·5441?
4.	·5329?	11.	·12082576?
5.	5013·914481?	12.	·0089794576?
6.	17·3056?	13.	57592921?
7.	$\frac{242}{288}$, $\frac{676}{1296}$?	14.	72·0801?
8.	·000729?	15.	102030201?

NOTE 1. A mean proportional between two given numbers is the square root of their product.

NOTE 2. In any right-angled triangle, the square of the hypotenuse, or side opposite the right angle, is equal to the sum of the squares of the other two sides.

NOTE 3. The areas of circles and the surfaces of spheres are to each other as the squares of their diameters.

NOTE 4. The side of a square of any given area is equal to the square root of that area.

16. Required the mean proportional between 2057 and 17?

17. A square plantation contains 670761 trees, which were planted at the distance of 19 feet; required the length of a side of the square?

18. A ladder is to be fixed in the ground 15 feet from the base of a wall 20 feet high; how long must the ladder be to reach the top?

19. A line stretched from the top of a tower to a station 87 feet from its base, measured 145 feet; what was the height of the tower?

20. In a gentleman's pleasure-grounds are two circular ponds; the one is 4 times as large as the other, whose diameter is 60 yards; required the diameter of the other?

21. The gilding of a globe 30 inches in diameter cost £2, 10s.; what would the gilding of one cost whose diameter is 45 inches?

TO EXTRACT THE CUBE ROOT.

RULE. Divide the given number from the unit's place into periods of three figures. Find the greatest cube in the left-hand period, put its root in the quotient, subtract the cube from that period, and to the remainder annex the next period for a dividend. Multiply the square of the root by 300 for a divisor, and take it out of the dividend, the quotient is to be tried for the next figure of the root. Multiply the part of the root formerly found by 30 times the trial-figure, and place the product under the divisor, below this product write also the square of the trial-figure, then multiply the sum of these by the trial-figure, subtract the product from the dividend, and to the remainder annex the next period for a new dividend.

To the complete divisor add the two lines above it, taking in the last one twice, and to the sum annex two

ciphers for a new divisor, with which find another trial-figure, and proceed as before.

1. Required the cube root of 48627125?

48,627,125(365 root
27
2700)21627
540
36
3276 19656
388800) 1971125
5400
25
394225 1971125

2.	15625?	9.	·000117649?
3.	52734375?	10.	485587656?
4.	484846678016?	11.	592704?
5.	11390·625?	12.	7189057?
6.	·041063625?	13.	5·639752?
7.	$\frac{1728}{2197}, \frac{2744}{4913}$?	14.	48·627125?
8.	3?	15.	10?

NOTE. Similar solids are to one another as the cubes of their corresponding lineal dimensions. Globes, and balls of the same metal, are therefore to one another as the cubes of their diameters.

16. If a globe, of which the diameter is 6 inches, weighs 18 lb.; what will be the diameter of a globe of the same metal which weighs 144 lb.?

17. A block of marble is 126 in. long, 84 broad, and 56 thick; required the side of a cube equal to it?

18. Required the side of a cubical vessel that will contain 100 I. S. gallons?

19. The length of a cistern is 5 feet, breadth 3 ft. 4 in., and depth 2 ft. 6 in.; required the dimensions of another 6 times as large?

DUODECIMAL MULTIPLICATION.

RULE. Multiply each name of the multiplicand by the feet of the multiplier, beginning at the lowest, and carrying at 12; and place each product under that name of the multiplicand which produced it. Next multiply in the same way by the inches of the multiplier, and set each product a place farther to the right hand. Then multiply by the parts, and set the products another place farther to the right, and so on; the sum of the products is the answer.

NOTE. A foot is divided into 12 inches, an inch into 12 parts, or primes, a prime into 12 seconds, &c.

	ft.	in.	pt.		ft.	in.	pt.
1. Multiply	48	6	0	by	3	4	0
2. Multiply	891	5	0	by	9	8	0
3. Multiply	78	11	4	by	7	8	3
4. Multiply	23	0	7	by	10	7	3
5. Multiply	20	7	0	by	13	4	7
6. Multiply	49	2	3	by	16	8	6
7. Multiply	37	4	4	by	21	6	3
8. Multiply	46	11	3	by	26	8	8
9. Multiply	52	0	11	by	30	6	0
10. Multiply	81	9	10	by	40	6	3
11. Multiply	84	7	5	by	39	5	2
12. Multiply	94	9	9	by	46	11	10

Artificers generally estimate their work by duodecimals.

To find the content of surfaces, multiply the length by the breadth; and for solids, multiply the length by the breadth, and the product again by the thickness.

13. How many feet in a deal 27 feet 8 inch. in length, and 2 ft. 3 in. 7 pts. in breadth?

14. How many feet in a floor 46 feet 8 inches long, and 25 ft. 8 in. broad?

15. How many feet in 8 windows, each 7 ft. 8 in. pts. by 4 ft. 9 in. 8 pts.?

16. What is the solid content of a log 36 ft. 6 in. long, 3 feet 4 in. 2 pts. broad, and 1 ft. 11 in. 3 pts. thick?

17. What is the solidity of a stone 13 ft. 8 in. long, 7 ft. 9 in. broad, and 3 ft. 11 in. thick?

18. How many gallons, standard measure, will a cistern contain, of which the dimensions are 38 ft. 6 in. 23 ft. 4 in., and 11 ft. 9 in.?

MISCELLANEOUS QUESTIONS.

1. After taking 1486 from a number. 2075 remained; what was that number?

2. A number being divided by 758 gave 2468 for the quotient; what was that number?

3. The remainder of a division is 325, the divisor is 467, and the quotient is 43 greater than the sum of the two; what is the dividend?

4. A merchant's capital at the beginning of the year was £5719, 14s. 6d. and his gain at the end of it was £1078 18s. 9d.; what was he then worth?

5. A man's annual income is £500, and his daily expenses £1, 3s.6½d.; what does he save?

6. A man earns £1, 13s in a week, and his daily expenses are 3s. 10½d.; what does he lay up at the year's end?

7. Two persons depart at the same time from the same place,—one of them travels 30 miles per day, and the other 35 miles; how far will they be distant from one another at the end of 10 days if they both travel the same way, and how far if they travel in contrary directions?

8. A father's estate was divided among his three sons,—the first gets £5000, the second $\frac{3}{4}$ of the first, and the third $\frac{5}{6}$ of the second; what was the value of the estate?

9. Bought 72 stones of butter at 23s. per st. of 16 lbs., (1 lb.=24 avoir. oz.,) and sold it at 18d. per lb. avoir.; what was gained?

10. Bought 8 hhds. of spirits, each containing 52 imperial gallons, and weighing 8 cwt. 3 qrs. 24 lb.; I was allowed 17½ lbs. tare per cwt.; what did the whole cost at 8s. 9d. per gallon?

11. A garrison of 2000 men has provisions for 5 months of 4 weeks each; it is re-enforced with 500 men; how long will the provisions last them?

12. How much hay will serve 32 horses for 96 days at the rate of 29 lbs. each per day?

13. In a town containing 14,520 inhabitants, one out of 33 dies annually, and there are 5 births for 4 burials, and 12 girls are born for 13 boys; how many boys and girls are born there annually?

14. An oak which grows 6 inches annually is of the same height with a fir 24 years old, which has grown 10 inches annually; what is the age of the oak?

15. If the freight of a ship of 170 tons for 3 months is £102, what should be the freight of a ship of 118 tons for 5 months?

16. Suppose the surface of a man's body to contain 16 square feet, and that there are 968 pores in a square inch; what is the diameter of each pore, supposing it round, or its side supposing it square, and the film between the pores to be ⅛ of the diameter or side, and how many pores are in the body?

17. In what time would wind move from the pole to the equator, a distance of 6214 miles, at the rate of 2¾ miles in an hour?

18. The earth makes one revolution round its orbit in 365 days 5 hours 48 minutes 48 seconds, and this orbit is 596,902,655 miles in circumference; what distance does the earth move in an hour?

19. If gun-metal is composed of 100 parts of copper and 11 of tin, how much of each will be required to make a cannon which weighs 16 cwt. 1 qr. 20 lbs.?

20. Suppose bell-metal to be composed of 3 parts of copper and 1 of tin; how much of each is in a bell weighing 150 lbs.?

21. How much water and pure spirit are in 84 gallons

of proof spirits, which consist of 48 parts of alcohol and 52 of water?

22. How much water must be added to a cask containing 84 gallons of spirits at 13s. 6d. to reduce the value to 11s. 4½d.

23. A man's male labourers are paid 1s. 4d. per day, and he has 21 female labourers at 11d. per day; the amount of the wages at an average is 14½d. for each per day; how many men had he?

24. A father bequeaths £7000 to his three sons in such proportions that 5 times the eldest, 6 times the second, and 7 times the third, make the same number; what are their shares?

25. Three men purchase a ship; the first pays $\frac{2}{9}$ of her, the second $\frac{2}{7}$ of her, and the third £2000; what did the two first pay?

26. The gain of A. and B together amounted to £13, 10s., that of B and C together to £12, 12s., and of A and C together to £11, 16s. 6d.; what was the gain of each?

27. If 3 men and 4 women do a piece of work in 56 days, in what time will it be done by employing one of each sex, supposing a woman to do $\frac{5}{6}$ of a man's work?

28. I mixed 35 lb. of tea with 20 lb. which were 1s. 10d. per lb. dearer, the mixture was worth 7s. 4d. per lb.; what was the value of each kind?

29. A merchant bought 3 tuns wine, each 210 gallons, but having received damage, he sold the whole for £330, 15s., which was at 12 per cent. loss; how much did the wine cost per tun, and what was the gallon sold at?

MENSURATION.

DEFINITION OF SUPERFICIES.

1. There are two kinds of extent.

1st. The extent in length only.

2d. The extent in length and breadth, and called *plane* or *superficies*.

3d. The extent in length, breadth, and thickness, and is called *body* or *solid.*

2. To measure an extent in length, it is to seek how many times it contains a known length.

3. The mensuration of superficies can be reduced to those of square, rectangle, triangle, trapezium, rhombus, circle, and sphere.

4. All superficies which are straight parallel lines one with another, are called *parallelogram.*

5. A *square* is a quadraliteral, whose sides are equal, and its angles all right, as A B C D, fig. 1.

6. An *angle* is the inclination or opening of two right lines, which meet in a point without cutting each other, as fig. 2.

7. A *rectangle* is a parallelogram, whose angles are all right, as fig. 3.

8. A *triangle* is a figure bounded by three right lines, as fig. 4.

9. A *trapezium* is a parallelogram, whose angles are not right angles. The figure 5 is called rhomboid.

10. *Parallel right lines* are such as are every where at an equal distance from each other, as fig. 6.

11. A *rhombus* is a quadrilateral, whose sides are all equal, but its angles are not right angles, as fig. 7.

12. A *circle* is a plane figure, formed by the revolution of a right line about one of its extremities, which remain fixed, as fig. 8.

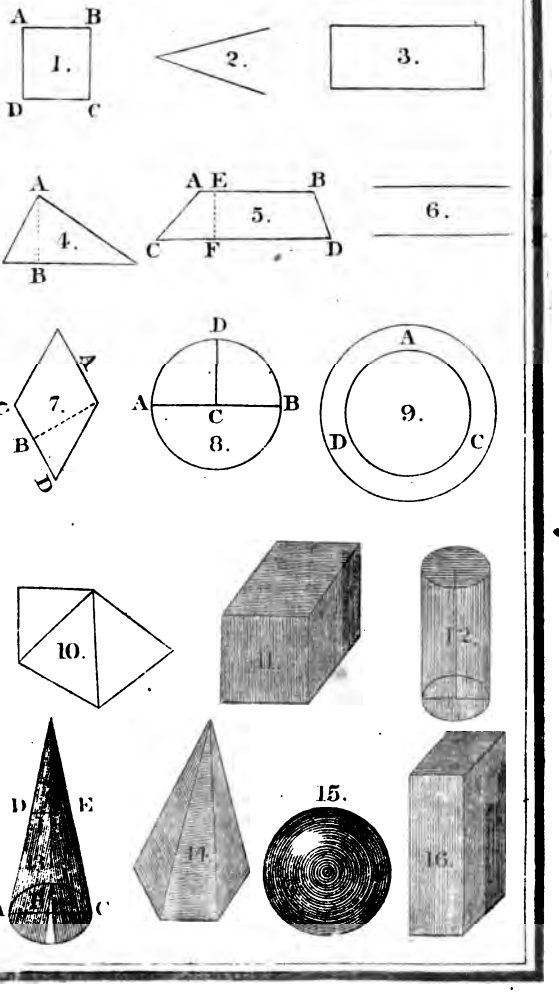
13. The *centre* of a circle is the point C about which it is described; and the *circumference* is the line A D B A which is divided into 360 parts, called *degrees.*

14. The *radius* of a circle is a right line drawn from the centre to the circumference, as C D, fig. 8.

15. The *diameter* of a circle is a right line passing through the centre, and terminated on each side by the circumference.

MENSURATION OF SUPERFICIES.

16. *Mensuration of superficies* teaches how to find


A
B
1.
D
C
2.
3.
A
4.
B
A E
B
5.
C
F
D
6.
7.
B
D
D
A
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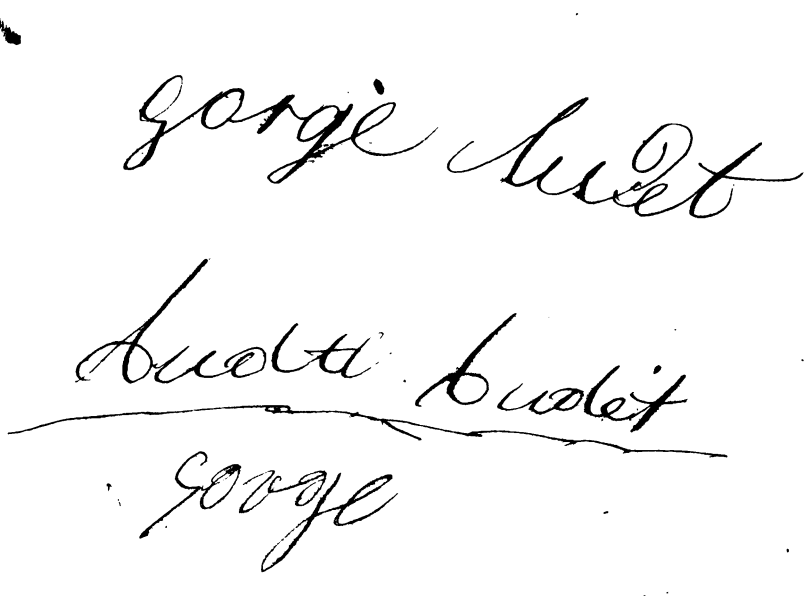

the area or superficial content of any figure, without any regard to its thickness.

17. We obtain the superficies of a *square* by multiplying the side by itself.

18. We obtain the superficies of a *rectangle* by multiplying the length by the breadth.

19. We obtain the area of a *triangle*, 1st, by multiplying the base B by the perpendicular height A B, fig. 4. 2d, When the sides are given, add all the three sides together, and take half that sum; next subtract each side severally from the said half sum, then multiply that half sum and the three remainders together, and extract the square root of the product for the area of the triangle.

EXAMPLE. Required the area of a triangle, whose sides are 13, 14, and 15 feet.

SOLUTION. $13+14+15=42\div2=21-13=8$, 1st rem.; $21-14=7$, 2d rem.; $21-15=6$, 3d rem.; $21\times8=168\times7=1176\times6=7056\sqrt[2]{}$. Ans. 84 sq. ft.

20. To obtain the superficies of a *trapezium* we must add the two parallel lines AB, CD, fig. 5, take the half of their sum and multiply this half by the perpendicular breadth EF, and the product will be the area.

Or, add the two perpendiculars together, multiply that sum by the diagonal, and take half the product for the area.

21. To obtain the superficies of a *rhombus*, multiply the side CD by the perpendicular breadth AB, fig. 7, and the product will be the area.

22. To obtain the superficies of a *circle*, we must multiply the length of the circumference by the half of its radius.

23. We obtain the circumference by that proportion 7 : 22 : : the diameter given is to the circumference of the circle to which it belongs.

24. We will find the diameter by this proportion 22 : 7 : : the circumference is to the diameter.

25. 1st. We can also find the circumference by multiplying the diameter by 3,1416.

2d. Divide the circumference by 3,1416=the diameter.

3d. Square the diameter, and multiply it by 0,7854 gives the area.

4th. Square the circumference and multiply it by 0,07958 gives the area.

5th. Divide the area by 0,7854, and extract the square root, gives the diameter.

6th. Divide the area by 0,07958, and extract the square root, gives the circumference.

26. To obtain the superficies of the crown ABC, fig. 9, we must subtract the area of the little circle from that of the great, considered as containing the total superficies.

27. To find the superficial content of a sphere, multiply the circumference by the diameter, or multiply the square of its diameter by 3,1416.

28. To obtain the superficies of all other poligons, regular or irregular, as fig. 10, we must divide them into triangles by diagonals, and find the area of each of them separately; then add these areas together, their sum will be the area of the whole figure.

29. To obtain the superficial content of a pyramid or cone, multiply the perimeter ABC, fig 13, of the base by half of the slant height, to which add the area, if requisite.

30. To find the superficies of a cylinder, multiply the perimeter or circumference of the base by the height or the length of the cylinder, to which add the areas of the two ends, if required give the whole surface; it is the same for a prism.

EXERCISE.

P. 1. How many square yards in a square, whose side is 20 ft.?

P. 2. How many acres in a square field, whose side is 50 poles?

P. 3. Required the area of a rectangular board, whose length is 12 feet, and breadth 2 feet?

P. 4. What is the area of a rectangle, whose length is 14 feet 6 inches, and breadth 4 feet 9 inches?

P. 5. Required the area of a rhombus, the side being 4 ft. 10 in. and the perpendicular 18 in.?

P. 6. Required the content of a rhombus, the length of whose side is 12 feet, and its height 10 ft. 6 in.?

P. 7. What is the area of a rhomboid, whose length is 7 ft. 9 in. and height 3 ft. 6 in.?

P. 8. What is the area of a triangle, whose base is 20 feet, and the perpendicular 5 feet?

P. 9. Required the area of a triangle, whose base is 12, 25, and height 8, 5 chains?

P. 10. Required the area of a triangle, whose sides are 20, 30, and 40?

P. 11. Required the area of an equilateral triangle, each of whose sides is 25 chains?

P. 12. Required the area of an isosceles triangle, whose base is 20, and each of its equal sides 15?

P. 13. Required the area of a right-angled triangle, whose hypotenuse is 50, and the other sides 40 and 30?

P. 14. How many acres are there in the triangle, whose three sides are 380, 420, and 765 yards?

P. 15. Required the area of a trapezium, whose diagonal is 40, and the two perpendiculars 20 and 10?

P. 16. Required the area of a trapezium, whose diagonal is $80\frac{1}{2}$, and the two perpendiculars $24\frac{1}{4}$ and $30\frac{1}{10}$?

P. 17. What is the area of a trapezium, whose parallels are 25 and 32 yards, and the height $12\frac{1}{2}$?

P. 18. How many acres are there in the trapezium, whose diagonal is 4, 75 chains, and the two perpendiculars falling out is 2, 25, and 3, 6 chains respectively?

P. 19. If the diameter be 26, what is the circumference?

P. 20. If the circumference is 75, what is the diameter?

P. 21. What is the diameter of a circle, whose circumference is 50 feet?

P. 22. What is the area of a circle, whose diameter is $5\frac{1}{2}$ feet?

P. 23. How many square yards are there in a circle, whose circumference is $10\frac{3}{4}$ yards?

P. 24. How many square yards are there in a circle, whose radius is $15\frac{1}{4}$ yards?

P. 25. It is required to find the radius of a circle, whose area is an acre?

DEFINITION OF SOLIDS.

31. Mensuration of solids teaches how to find the whole capacity or content of any solid, considered under the triple dimensions of length, breadth, and thickness.

32. The solids, the most common, are cube, parallelopiped, cylinder, cone, pyramid, sphere, and prism.

33. A *cube* is a solid contained by six equal square sides or faces, as fig. 11.

34. A *parallelopiped* is a solid contained by six rectangular plane faces, every opposite two of which are equal and parallel, as fig. 16.

35. A *cylinder* is a solid, whose surface is circular, nd its ends two circular planes, as fig. 12.

36. A *pyramid* is a solid, whose sides are all triangles, meeting in a point at the vertex, and the base any plane figure, as fig. 14.

37. A *sphere* or *globe* is a solid described by the revolution of a semicircle about its diameter, which remains fixed, as fig. 15.

38. A *cone* is a solid, as the pyramid, but whose base is a circle, as fig. 13.

MENSURATION OF SOLIDS.

39. To find the solid content of a cube, prism, or cylinder, find the area of the base, or end, and multiply it by the height or length of the figure, gives the solid content.

40. To find the solid content of a pyramid or cone, multiply the area of the base by one-third of the perpendicular height, gives the solid content.

41. To find the solid content of the frustum of a pyramid or cone; to the areas of the two ends of this frustum add the square root of their product, and this sum being multiplied by a third of the height, will give the solidity.

42. Multiply the sum of the perimeters or circumferences

of the two ends, by the slant height of the frustum, and half the product will give the superficial content.

EXAMPLE. Required the solid content of the frustum of the cone ADEC, fig. 13, the diameter of whose great end AC is five feet, that of the less end DE is three feet, and the perpendicular height IB 9 feet?

SOLUTION. $5\times5=25\times0,7854=19,6350$ area of AC; $3\times3=9\times0,7854=7,0686$ area of DE $\times 19,6350 = 138,79196100$ $\sqrt[3]{\ } = 11,781+19,6350+7,0686=38,4846\times\frac{1}{3}$ of perp. 3.—Ans. 115,4538 solid content.

43. To find the solid content of a sphere: cube the diameter and multiply it by 0,5236; or multiply its surface by one-third of the radius.

EXERCISES ON SUPERFICIES AND SOLIDITY.

P. 26. What is the superficial content of a parallelopiped, whose length is 8 feet, its breadth $4\frac{1}{2}$ feet, and its depth $6\frac{3}{4}$ feet?

P. 27. What is the superficial extent of a cube, the length of each side being 20 feet?

P. 28. What is the superficial content of a triangular prism, whose length is 20 feet, and each side of its end or base is 18 in.?

P. 29. Find the convex surface of a round prism, or cylinder, whose length is 20 feet, and the diameter of its base 2 feet?

P. 30. What is the solid content of a centre, whose side is 24 inches?

P. 31. How many cubic feet in a block of marble, its length being 3 ft. 2 in., breadth 2 ft. 8 in., and thickness 2 ft. 6 in.?

P. 32. Required the solidity of a triangular prism, whose length is 10 feet, and three sides of its triangular end or base at 3, 4, 5 feet?

P. 33. Required the content of a round pillar or cylinder, whose length is 20 feet and circumference 3 ft. 6 in.?

P. 34. What is the solid and superficial content of a

cone, the diameter of whose base is 6 feet, and the slant height is 10 feet?

P. 35. What is the superficial content of a triangular pyramid, the slant height being 20 feet, and each side of the base 3 feet?

P. 36. Required the surface of a cone, the slant height being 50 feet, and the diameter of the base $8\frac{1}{2}$ feet?

P. 37. Required the solidity of a square pyramid, each side of its base being 30 feet, and its perpendicular height 25?

P. 38. Find the solid content of a triangular pyramid, whose perpendicular height is 30, and each side of the base 3?

P. 39. What is the content of a pentagonal pyramid, its height being 12 feet, and each side of its base 2 feet?

P. 40. Required the content of a cone, its height being $10\frac{1}{2}$ feet, and the circumference of its base 9 feet?

P. 41. What is the solidity of the frustum of a cone, the diameter of the greater end being 4 feet, and of the less end 2 feet, and the altitude 9 feet?

P. 42. What is the solidity of the frustum of a square pyramid, one side of the greater end being 18 inches, that of the less end 15 inches, and the height 60 in.?

P. 43. What is the solidity of the frustum of an hexagonal pyramid, whose length is 12 feet, one side of the greater end is 3 feet, that of the less end 2 feet?

P. 44. What is the superficial content of the frustum of a square pyramid, whose slant height is 10 feet, one side of the greater end being 3 ft. 4 in. and of the less end 2 ft. 2 in.?

P. 45. To find the convex surface of the frustum of a cone, the slant height of the frustum being $12\frac{1}{2}$ feet, and the circumference of the two ends 6 and 8,4?

P. 46. What is the solid and superficial content of a sphere, whose diameter is 17 inches?

P. 47. What is the solidity of a sphere, whose diameter is $1\frac{1}{3}$ feet?

P. 48. What is the solidity of the earth, supposing it to be perfectly spherical, its diameter being $7957\frac{3}{4}$ miles?

P. 49. What is the convex superficies of a sphere, whose diameter is $1\frac{1}{3}$ feet, and the circumference 4,1888 eet?

P. 50. If the diameter or axis of the earth be $7957\frac{3}{4}$ miles, what is the whole surface, supposing it to be a perfect sphere?

ARITHMETICAL PROGRESSION.

An Arithmetical Progression is a series or rank of numbers, uniformly increasing or decreasing, by the constant addition or subtraction of some number called the common difference: Thus, 1, 2, 3, 4, 5, is an increasing arithmetical series where the common difference is 1, and 10, 8, 6, 4, 2, is a decreasing arithmetical series, where the common difference is 2.

Of these five, viz. the two extremes, common difference, number of terms, and sum of the series; having any three given, the other two may be found.

THEOREM. The sum of the extremes is equal to the sum of any two means equally distant from them.

PROBLEM I. Given the extremes and number of terms, to find the other two.

RULE. The common difference is equal to the difference of the extremes divided by the number of terms minus one; and the sum of the series is equal to the sum of the extremes multiplied by half the number of terms.

1. Given the extremes 12 and 42, and the number of terms 11; required the common difference, and sum of the series?

2. A person owed a certain sum, which he paid in 13 different payments, increasing in arithmetical progression; the first payment was 3s., the last £2, 11s.; how much did each payment exceed the former, and how much did he owe in all?

3. A farmer bought 100 sheep, and gave for the first

1s., and for the last £19, 17s.? what did he give for the whole, and how much did the price of any one exceed that of the preceding?

PROBLEM II. Given the extremes and common difference, to find the number of terms and sum of the series.

RULE I. Divide the difference of the extremes by the common difference; the quotient plus one will be the number of terms.

II. Divide the difference of the squares of the extremes by twice the common difference, and this quotient added to half the sum of the extremes will give the sum of the series.

4. Given the extremes 7 and 103, and the common difference 4; required the number of terms and sum of the series?

5. A nurseryman planted a number of firs in the form of an isosceles triangle; he put one plant in the first row, 3 in the second, and so on in arithmetical progression; the last row contained 61 plants; required the number of rows, and the whole number of plants?

6. A person meeting with a number of poor people, gave the first 2d., the second 5d., and so on until the last, to whom he gave 2s. 8d.; required the number of poor people, and how much they received in all?

7. A person travelling from one city to another, went 6 miles the first day, 9 the second, and so on in arithmetical progression: his last day's journey was 60 miles; required the number of days he travelled, and the distance of the cities?

PROBLEM III. Given the common difference, number of terms, and sum of the series, to find the rest.

RULE. Divide the number of terms minus 1 by 2; multiply the common difference by the quotient; add and subtract this product to and from the sum of the series divided by the number of terms; the sum and remainder will be the greatest and least terms respectively.

8. Given the number of terms 9, the common difference 2, and the sum of the series 135; required the extremes?

9. A person discharged a debt of £210, 12s. in a year, by paying every week 3s. more than he did the preceding; quere, the first and last payments?

10. A courier by increasing his day's journey 3 miles every day, travels 345 miles in 15 days; required his first and last day's journey?

11. A horse-dealer buys 10 horses for £110, the difference of their prices being £2; what did the first and last cost him?

PROBLEM IV. Given either of the extremes, the common difference, and number of terms, to find the rest.

RULE. Multiply the common difference by the number of terms minus 1; this product, added to the less extreme, gives the greater, or, subtracted from the greater extreme, leaves the less.

Add said product to twice the least extreme, or subtract it from twice the greater; multiply the sum or the remainder by half the number of terms; either of these will give the sum of the series.

12. Given the least extreme 12, common difference 3, and number of terms 11; required the greater extreme, and sum of the series?

13. Given the greater extreme 123, common difference 5, and number of terms 24; required the less extreme, and sum of the series?

14. A sum of money was divided among 12 persons, whose shares were in arithmetical progression; the first received 3s., the second 7s., and so on; required the sum divided among them, and the share of the last?

15. A traveller sets out on a journey, which he accomplishes in 15 days, by travelling every day 3 miles more than he did the preceding, and travelled 49 miles the last day; required how many miles he travelled the first day, and the length of the journey?

THE END.